AGRICULTURAL COMMODITY OPTIONS: AN EVALUATION OF PERFORMANCE IN ROUTINE LIVE CATTLE HEDGES

by

SCOTT ANTHONY LANGEMEIER

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Approved by:

Orlen C. Grunewald
Major Professor

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CHAPTER I

INTRODUCTION

In the past, producers who wanted to reduce risk and uncertainty by "locking in" a futures price on a commodity had two alternatives, forward contracting and taking an appropriate position in the futures market. With the recent introduction of commodity options on futures contracts, a new avenue was created to market livestock. This greatly expands the marketing alternatives available to cattle producers.

Option trading strategies are historically considered to be complex, but with proper understanding of their underlying principles, most livestock producers can effectively use options as a marketing tool. With the addition of options, a short hedger can trade "in-the-money", "out-of-the-money", and "at-the-money" options. In addition, there are over fifteen recognized spreads traded by investors (Becker and Degler).

Some of these strategies are relatively simple, while some are more complex and should only be traded by experienced investors who completely understand all of the risks involved in these trades. Certain strategies can be, and have been, the topic of whole books. A producer who utilizes both option-based strategies as well as the traditional methods is certainly more versatile in marketing fed cattle than someone who uses only futures hedging. Options will not guarantee that a producer will make a profit, but that is not necessarily the objective when buying insurance. Options are not a

panacea for managing risks, they merely alter the risk/reward structure.

Research Hypothesis

To date, there is no best single hedging approach.[1] The optimal trading strategy in any given situation will depend upon the prevailing option premium levels and the specific nature of the expected price trend. Many studies suggest that routinely hedging cattle production using futures markets reduces the variability of income but also reduces net income realized by cattle feeders when compared to cash only marketing.[2]

The hypothesis this research will demostrate is that routinely placed option-based hedging strategies can produce net returns similar to cash marketing over an extended time period (1980 - 1985), and will significantly reduce the variability of income associated with Kansas cattle feeding operations, when compared to unhedged cash sales. This study will also show that option-based hedging strategies, when compared to cash marketing, can both increase net returns and decrease the variability of income for shorter periods of time (one year).

Each option hedging strategy contains elements that cause it to react differently to price movements. Characteristics associated with put options allow for protection against downward price movements in the same manner that call options protect against price appreciation. To effectively use options as a hedging tool, one must first have an idea of the future price trends.

Figures 2, 3, 4, 5, 6 and 7 clearly show that price trends have

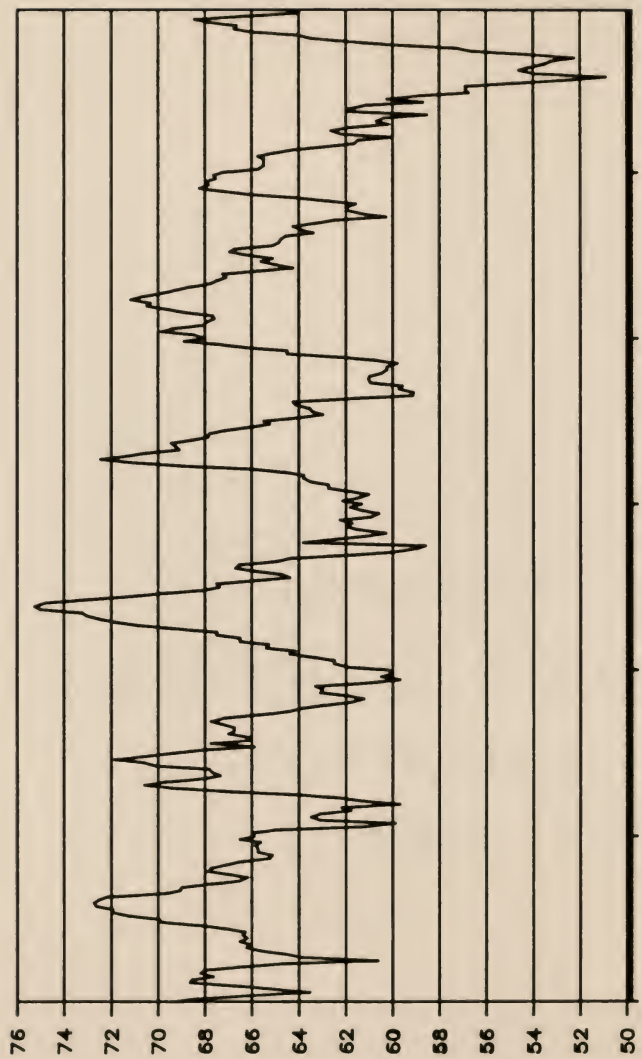

Figure 1. Weekly average cash slaughter cattle prices for Dodge City, Kansas, 1980-1985

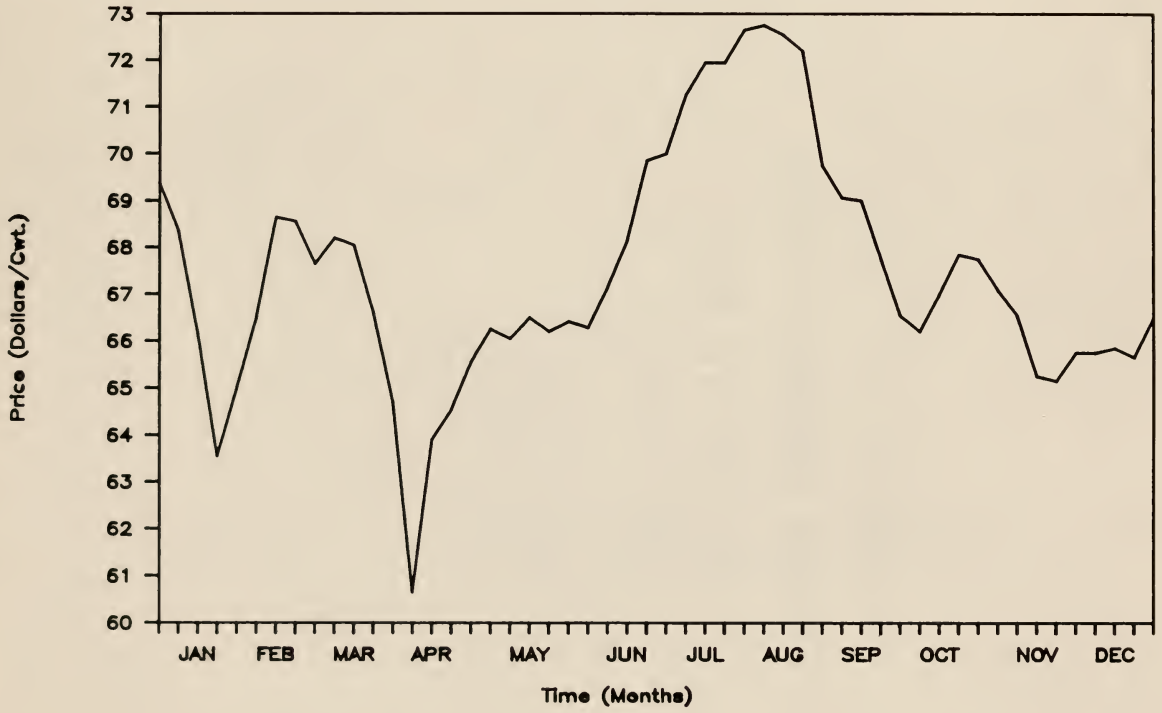

Figure 2. Weekly average cash slaughter cattle prices for Dodge City, Kansas, 1980

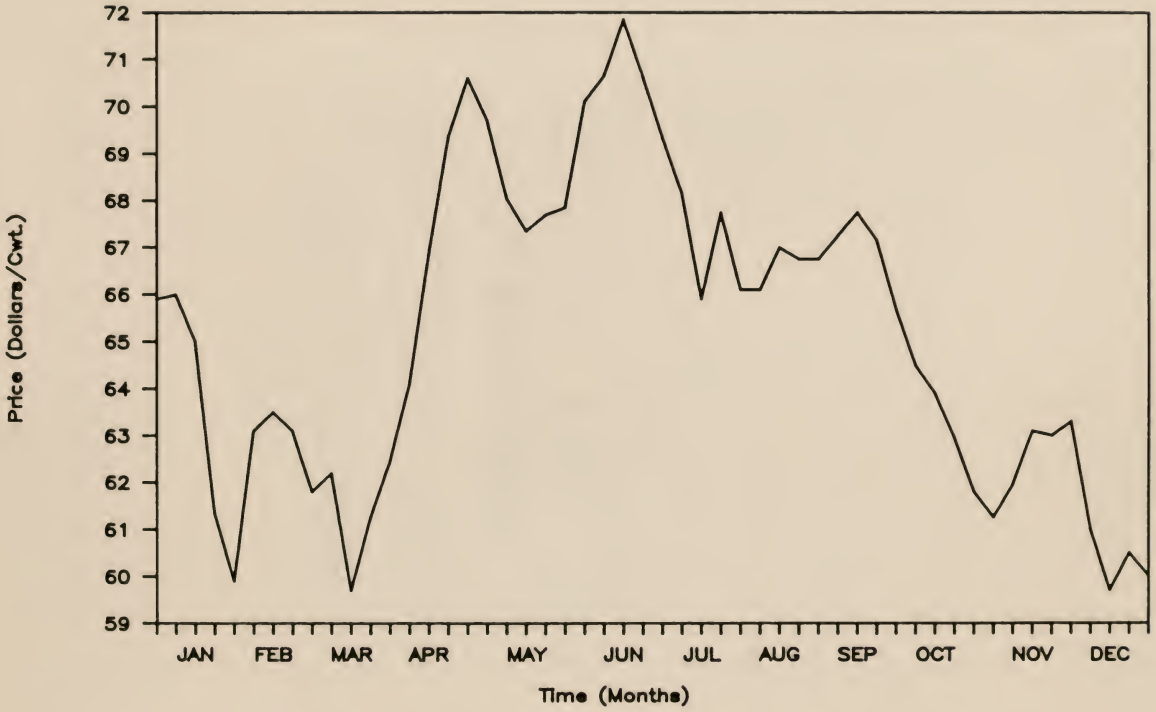

Figure 3. Weekly average cash slaughter cattle prices for Dodge City, Kansas, 1981

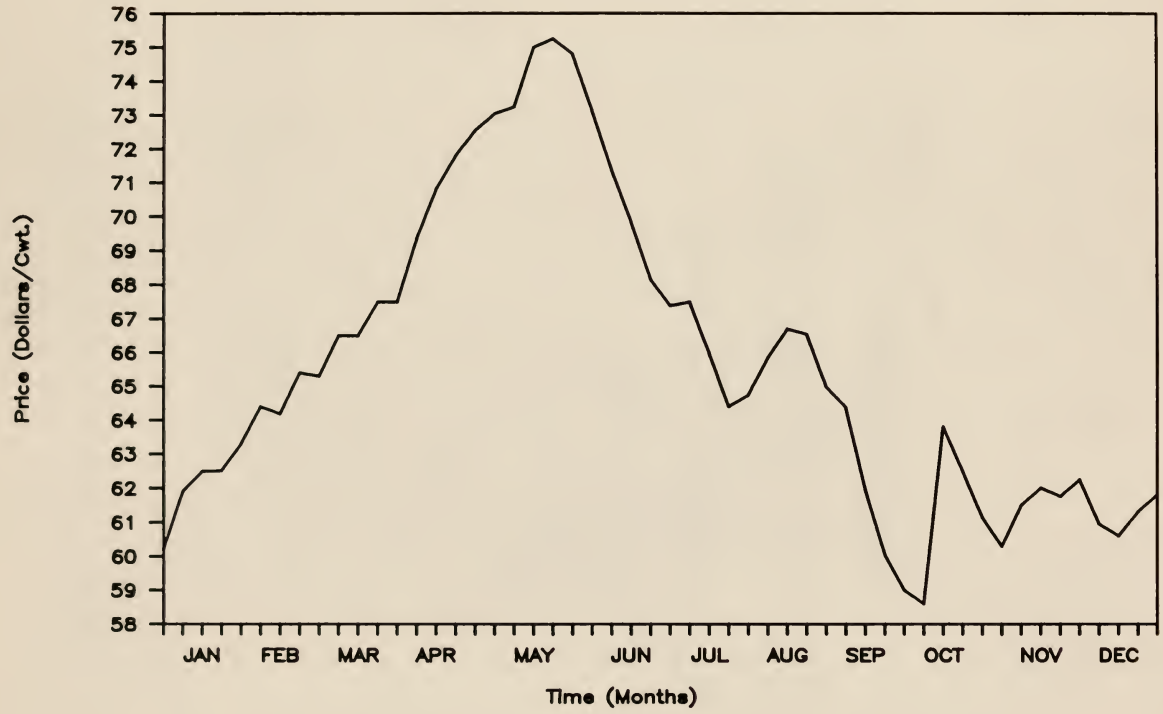

Figure 4. Weekly average cash slaughter cattle prices for Dodge City, Kansas, 1982

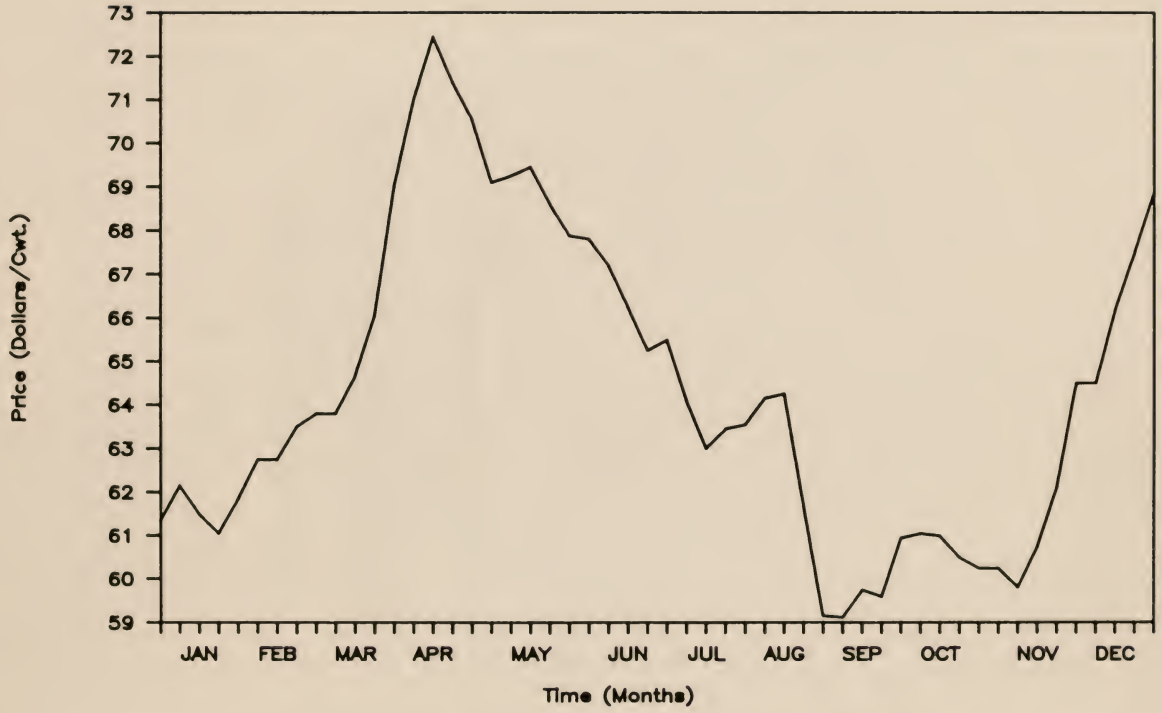

Figure 5. Weekly average cash slaughter cattle prices for Dodge City, Kansas, 1983

Figure 6. Weekly average cash slaughter cattle prices for Dodge City, Kansas, 1984

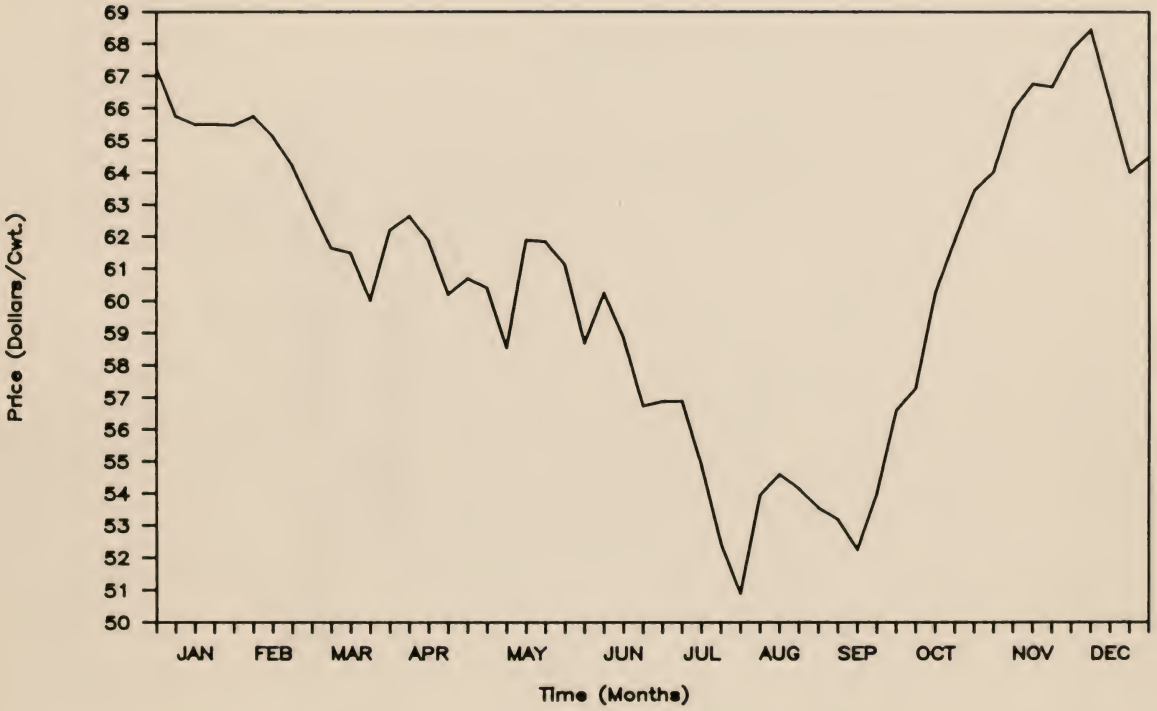

Figure 7. Weekly average cash slaughter cattle prices for Dodge City, Kansas, 1985

been sustained for the greater part of a single year. Consequently, hedging strategies designed to capture additional profits during a certain price trend should prove superior to cash marketings. For years that are dominated by a steady or sideways trend, selling call options is expected to be a leading strategy. When a downward trend dominates, buying puts and futures short hedges should be the most profitable. When an upward trend is sustained, cash sales should dominate all option strategies.

Objectives

In October, 1983, the Commodity Futures Trading Commission (CFTC) lifted the ban on the trading of options on agricultural futures. In October of 1984, the Chicago Mercantile Exchange (CME) began trading options on live cattle futures as part of a three year pilot program. On January 6, 1987, the CFTC voted to drop the pilot program status early and gave it a permanent status based on its success in the two preceeding years.[3] Options on commodity futures are here to stay, at least in the near future. Unfortunately, very little empirical research has been conducted to evaluate the proper use of this new tool to market live cattle.

The main objective of this study is to empirically evaluate various routine option hedging strategies. Buying puts and writing calls at seven different price levels and placing bear call spreads, bear put spreads and fence spreads at five different widths are the option strategies evaluated. Option-based hedges are routinely placed on 1600 pens of steers for a six year period (1980-1985).

Theoretically, a producer might use options on futures contracts as "price insurance" in the event the market moves lower, to achieve a higher effective selling price by gaining the option premium, or to reduce the variability of income. This study serves to evaluate options as a marketing alternative that reduces risk and increases net returns.

Thesis Summary

This is the first of six chapters. Chapter II includes a review of past studies involving futures and option-based hedging strategies. Option trading has its own vocabulary, therefore, a section of definitions is included in Chapter III. A theoretical option pricing model is used to determine option premia on futures contracts in the absence of option markets. The Black model for valuing option premia on futures contracts is outlined and discussed. Chapter III concludes by describing the futures and option strategies used in this study.

Chapter IV describes the method of data collection, and details the model and statistical manipulations used to evaluate the various hedging strategies. Theoretical futures hedges and option hedges are compared to actual cash marketings in Chapter V. This paper concludes with Chapter VI by interpreting the results, reviewing and evaluating the objective of this study and challenging the hypothesis that option hedging strategies can be as profitable, and are superior in risk reduction, as cash marketings, both long and short-term.

The results should be useful in providing an empirical evaluation of option hedging strategies relative to non-hedged production, and

will indicate how options can be utilized in an overall marketing regime.

Notes

1. Sporeleder and Winder (1985) suggest that writing calls is a leading strategy when the markets are stable.

2. Heifner, (1973); Menzie and Archer, (1973); Leuthold, (1974); McCoy and Price, (1975); Price, (1976); and many others.

3. Information obtained from the Financial Exchange, a publication of The Chicago Board of Trade.

CHAPTER II

LITERATURE REVIEW

Over the past fifteen years academia has produced many studies involving the effectiveness of selective hedging strategies for fed cattle. These strategies range from simple single commodity hedging strategies to a prehedge strategy involving the hedging of all major factors of production as well as the end product. As options were introduced, a greater opportunity for producers to hedge was also introduced. At this writing, very little empirical evidence is available on the use of options as a hedging instrument for a beef cattle producer.

The following is a partial review of the literature available on futures and option-based hedging strategies for live cattle.

Futures Hedging Strategies

Using Kansas feedlot data, McCoy and Price (1975) examined hedging strategies consisting of taking short futures positions after the cattle were placed on feed. This study differs from McCoy and Price in that the cattle were hedged the day they went on feed. In the McCoy and Price study, hedging was based on three price levels. The first price level was the calculated breakeven cost. Cattle were hedged if the futures hedge price equalled or exceeded the breakeven price. A similar hedge was placed if the futures hedge price equalled or exceeded the cash price for finished cattle at the time the cattle

went on feed. The final hedge was placed if the futures hedge price was greater than or equal to both the breakeven price and the fed cattle price the day the cattle went on feed.

Average profits on unhedged cattle for the ten year period, 1965 to 1974, were $9.55 per head. They found that a routine hedge reduced average profits to $0.18 per head and wiped out all windfall profits. When the cattle were hedged only if the futures hedge price equalled or exceeded the breakeven costs, profits would have been $11.81 per head. Had production been hedged only when the current cash cattle price was covered, average profits would have been $13.08 per head. The greatest profit, $14.43 per head, would have been realized had the cattle been hedged only if both prices were exceeded.

Carter and Loyns (1975) found different results when they used four selective hedging strategies for a feedlot operation in western Canada. In their study they included a total of 24,000 steers and 73,000 heifers marketed over a nine year period, 1972 to 1981. They concluded that using U.S. futures markets to routinely hedge would have reduced average profits and increased the risk on the majority of the lots of cattle fed. Basis risk and exchange rate problems were cited as possible reasons for the discrepancy.

While the forementioned studies were conducted using average costs and average cash prices, Gorman et al. (1982) used actual feedlot data for 747 pens of cattle over a period of 6.5 years. This study is very similar in the amount and type of data collected and the length of the time period studied. Hedging strategies evaluated by Gorman et al. were (1) routine hedging, (2) selective hedging, (3)

moving averages, (4) tolerance intervals and (5) the investment-feeder strategy. Cash losses incurred over the entire time period were $24.50 per head. They conclude that utilization of carefully chosen selective hedging strategies could reduce the average loss by nearly fifty percent while routine hedging decreased net income when compared to cash only marketing.

The frequency of which a cattle producer can use futures short hedges to profitably market cattle in Iowa was the topic of a study done by Hayenga et al. (1984). They found that a profit was attainable 51 percent of the days the futures market traded for producers with a nine month feeding period. The opportunity was somewhat lower (31%) for those producers utilizing a six month feeding period. A profitable opportunity was defined as $0.50/cwt. or more.

If a profit was attainable approximately 50 percent of the days traded, a producer could conceivably routinely hedge and be relatively successful. This tends to support the foundation for routine hedging.

This analysis does not consider selective hedging as a hedging strategy but several studies have been conducted which focus on this topic and deserve mentioning.

Spahr and Sawaya (1981) evaluated a "prehedge strategy" where a producer simultaneously prehedged all of the major factors of production (corn and feeder cattle) and the fed cattle. Prehedging extended as far back as seventeen weeks prior to purchasing the cattle. Cattle were put on feed weekly from 1974 to 1987 (261 weeks). The study shows that a feedlot operator who prehedges could increase his expected return and reduce the risk of operation as compared to

the feedlot operator who does not hedge.

Pluhar, Shafer and Sporleder (1985) evaluated eight monthly selective cattle marketing strategies over the 1975 to 1982 period. The eight strategies included: (1) cash marketing, (2) Purcell and Riffe hedging strategy (1980), (3) Shafer, Griffin and Johnson hedging strategy (1980), (4) Franzmann and Shields hedging strategy (1981), (5) Gorman et al. hedging strategy (1982), (6) Helmuth hedging strategy (1981), (7) synthesized 32-week integrated hedging strategy and (8) a synthesized 50-week integrated hedging strategy.

Each strategy used a different approach to signal a hedge placement. Purcell and Riffe used 4-, 5- and 15-day moving averages. Shafer, Griffin and Johnson used 10- and 15-day moving averages. Franzmann and Shields evaluated 2-, 7- and 13-day moving averages while Gorman et al. used 3- and 10-day moving averages. The Helmuth strategy used a signal which was comprised of an estimated breakeven plus a basis adjustment determined by Skadberg (1979). The hedge was placed if the daily high live cattle price quoted by the Chicago Mercantile Exchange (CME) was equal to or greater than the signal. The hedge was lifted when (if) the daily CME live cattle closing price dropped below the signal.

The 32- and 50-week integrated hedging strategies simulated input-output hedges where the inputs of production were long hedged and the fed cattle were short hedged. The 50- and 32-week integrated hedging strategies ranked first and second, respectively, in profitability above cash marketings. The 32-week strategy reduced the variance of income by 12 percent compared with cash marketing. The

Helmuth hedging strategy increased profits over cash marketing by $1.50 per head and reduced the variability of income in only four of the eight years studied.

The Franzmann and Shields strategy increased income and reduced variability compared with cash marketing. Purcell and Riffe's strategy reduced income variability but also reduced net profits. The strategy proposed by Shafer et al. decreased profits and increased variability of income. The Gorman et al. hedging strategy was only triggered six times over the eight year period and was unprofitable three of these times.

Option Hedging Strategies

One of the first studies involving options on live cattle was performed by Catlett and Boehlje (1982). In this study they set the option premiums equal to 5, 10 or 15 percent of the strike price of the option and the basis was allowed to fluctuate. Two option strategies were used. The first allowed the put option to expire and the second allowed the put option to expire only if a loss would not be realized in doing so. This study allowed the option to be offset if profitable or expire if a loss would be incurred by offsetting. Catlett and Boehlje concluded that 94 percent of the option hedges produced lower gross mean returns, while 80 percent of the option hedges had lower variances than routine futures hedges.

In simulating a commercial feedlot from 1974 to 1982, Hudson, Hauser, and Fortenbery (1985) used four hedging strategies to market 103 pens of cattle. The strategies were (1) routine futures hedge,

(2) routine put hedge, (3) moving average futures hedge and (4) moving average put hedge. The moving average futures and put hedges were placed when a 7/13 day moving average signaled to place the hedge. The hedges were lifted in the same manner. If the moving average did not signal to lift the hedge during the feeding period, it was lifted when the cattle were sold. The study suggests that routine hedging reduces the variance of returns while decreasing mean returns. The moving average hedging strategies provided higher mean returns with only a modest increase in variably of returns as compared to cash only marketing. Routine put hedging offered similar mean returns but increased variance considerably when compared to cash.

Sporleder and Winder (1985) examined the performance of put and/or call live cattle options as part of a portfolio of live cattle short hedges. Cattle were placed on feed the first day of each month and were sold after a 150 day feeding period from 1980 to 1984. Hedging strategies included; short futures, writing calls and long puts. Two quadratic programing models were used, one to minimize variance and the other to maximize income. A parameter for risk aversion was also included. A portfolio approach is not used in this research but the option hedging strategies are very similar.

Based on Texas Cattle Feeders Association data, actual average returns to cattle feeding in Texas over the time period studied were $2.40/cwt.. Net returns increased while variability of returns diminished with optimal portfolio strategies. Minimum variance hedges reduced the coefficient of net returns by 38 percent with a 13 percent increase in net returns. The optimal maximum profit portfolio

increased net returns by 53 percent for steers while income variability was reduced 37 percent. The authors also conclude that writing calls was a leading strategy in terms of hedging fat cattle production when cattle prices are stable.

Hauser and Eales (1987) estimated the risk/return levels of nine marketing strategies under price, variance and basis uncertainty. While this research was conducted on soybean futures, the information derived is very useful in formulating cattle marketing strategies. The nine strategies evaluated were (1) long puts, (2) short calls, (3) bear spreads (fences), (4) bull spreads, (5) short straddles, (6) long straddles, (7) short strangles, (8) long strangles and (9) short cash, long calls.

A $6.00 per bushel target was assumed the day the hedge was placed and the quantity hedged was fixed and known (5,000 bushels). Strategies one through four and nine involve the purchase, or sale, of one 5,000 bushel option contract, while strategies five through eight assume delta neutral positions. The options were priced using Black's model using an annualized interest rate of eight percent and an implied volatility of .23. This study differs in that a monthly interest rate was used but is similar in that a constant implied volatility and Black's model were used.

In the base case when all variables were held constant (price, variability and basis uncertainty), they found that as expected return increases so does expected risk for all strategies. The unhedged position had a risk/return level of .28 while the futures hedge position level was .09. Only the short cash, long call and long

straddle strategies had risk/return levels outside of the hedged versus unhedged boundaries.

When price and variance expectations were allowed to vary they found that when variance expectation is higher than the market's implied volatility, returns are greater than the variance for puts and returns are less than the variance for calls.

When the risk preference parameter was allowed to vary they found that the use of puts in short hedging is most likely when the seller is risk averse below the target price, risk seeking above the target price, and when the variance is expected to be higher than the implied volatility. The short hedger was more likely to use calls if he is risk seeking below the target price, risk averse above the target price, and when the variance was expected to be less than the implied volatility.

There were no effects of increasing basis risk for the long put and short call strategies if they were out-of-the-money by at least 50 cents. When the options were 50 cents in-the-money risk return levels increased. The delta hedges exhibited larger absolute responses in risk/return levels when basis risk was increased.

Summary of Relevant Literature

Reviewing the current literature on futures hedging strategies shows that when hedges are routinely placed, profits are reduced as income variability is reduced. Selective hedging strategies offer mixed results. Sporleder and Winder showed that selling calls when the market is in a sideways trend offers favorable results. This

study extends Sporleder and Winders' work by evaluating a greater number of strategies at different strike prices and uses a larger data base of actual data for a longer time period.

Optimally, a hedging strategy that increases net profits and reduces income variability compared with cash marketing is preferred. Therefore, option hedging strategies must be evaluated in an effort to find a marketing plan that achieves these results. This research evaluates option-based hedging strategies in an effort to find the most efficient marketing instrument currently available to cattle feeders.

CHAPTER III

THEORY OF OPTION PRICING AND OPTION STRATEGIES

To understand the concepts of options trading, one must first master the fundamental concepts associated with options trading. Fortunately, commodity options share many characteristics with nondividend paying American stock options. Therefore, much of the nomenclature and option trade strategies can be used intermittently between the two.

Option trading is no different from any other specialized field in the fact that it has its own vocabulary. Option trading tends to be relatively more complex than trading futures contracts. Therefore, a discussion of many of the terms and strategies used by option traders follows.

Definitions

An option is a contractual agreement to purchase or sell a particular asset, or financial right, such as live cattle futures contracts, for a specific predetermined price and within a certain time period. More specifically, there are two basic types or classes of commodity options, "calls" and "puts".

A call option gives the holder (or buyer) the right, but not the obligation, to purchase a fixed quantity of the underlying commodity (in this case the underlying commodity would be 40,000 pound live cattle futures contracts) at a fixed price at any time on or before a

given date.

The call writer (or seller) is obligated to sell the particular commodity upon the holder's demand and in accordance with the previously specified conditions. A put option gives the holder the right, but not the obligation, to sell a fixed quantity of the underlying commodity at a fixed price at any time on or before a given date. Similarly, the put writer is obligated to buy the particular commodity futures contract upon the holder's demand and in accordance with the previously specified conditions. Figure 8 shows the available opportunities for someone trading options.

Puts and calls are not offsetting transactions. They are, instead, independent contracts with distinct accounting characteristics. The opposite side of the call buyer is the call seller, and vice versa. In the same way, the opposite side of the put buyer is the put seller. The buyer of a call or put actually debits his account when he pays the premium while an option seller actually credits his account as he directly receives the premium. The premium money actually changes hands.

As figure 8 shows, the purchaser of an option acquires rights or privileges. He can either sell the option back at current market prices, exercise the option by taking an appropriate position in the futures market or let the option expire. While the option buyer acquires privileges, the option writer accepts obligations. In the case where the option buyer exercises an option, the seller is obligated to take the opposite side of the trade at the buyer's discretion. For example, if a trader who is long a put option decides

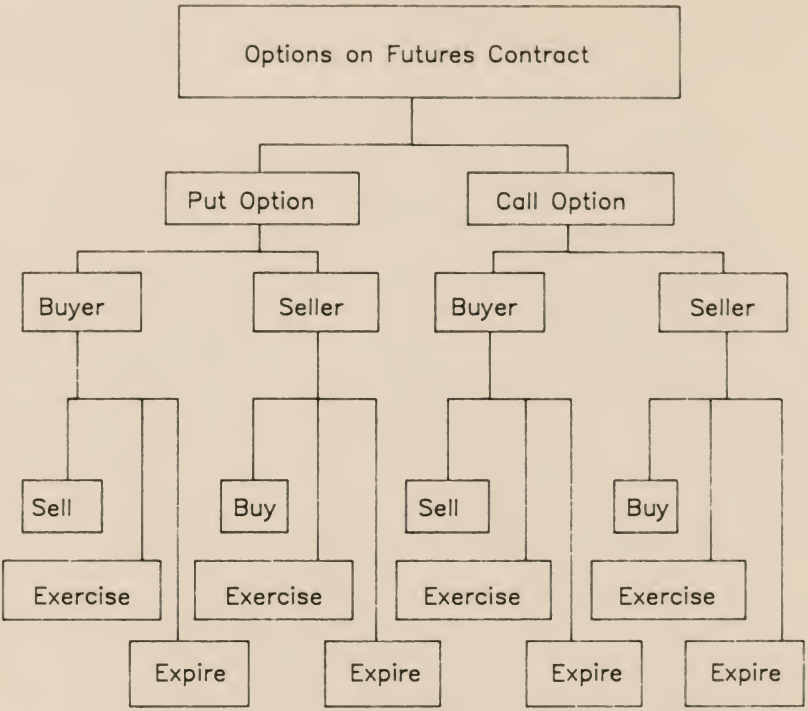

Figure 8. Commodity options flow chart

to exercise the put, the original seller of the put must take the opposite side of the underlying futures contract at the strike price regardless of the current market price. Thus, the writer must deposit margin money and is subjected to margin calls if the market should move against the option position. The option buyer also has the right to offset the option by selling an identical option. The option can be offset or exercised anytime prior to expiration. The rationale for choosing each of the alternatives will be discussed later in the paper.

As mentioned earlier, each option contract comes complete with its own specific conditions. The pre-determined price is known as a "strike" or "exercise price". The "underlying commodity" is the commodity or financial right to be bought or sold. The "premium" is the amount paid by the buyer or collected by the seller and is determined daily in the trading pits by open outcry and open auction. Therefore, the premium fluctuates just like the prices of the underlying commodity. The action of buying or selling the underlying commodity, the right given by the purchasing of a call or put option, respectively, is known as "exercising" the option.

The option holder's right to exercise the option contract expires on the expiration date. There is an important distinction between the option expiration date and the exercise date. The exercise date is the date upon which the option is actually exercised while the expiration date is the date upon which the rights of the option expire. Knowledge of this difference is needed to differentiate between a "European" and an "American" option. A European option can

only be exercised on the expiration date. American options can be exercised at any time on or prior to the expiration date at the holder's discretion. Thus, for a European option, the exercise date is the expiration date, while for its cousin, the American option, the exercise date can be different from the expiration date. From this point forward, any reference made towards options will be pertaining to American options.

An option contract for a particular commodity may be identified by the option "type", "class" and "series". There are two types of options - puts and calls. All option contracts of the same type written on the same underlying commodity constitute a class of options. Call and put options on the same underlying commodity are considered separate classes. Within a given class, all option contracts with the same expiration date and strike price constitute an option series.

Exchange traded commodity options are standardized with respect to the option contract terms. For live cattle options, the exchange sets the particular strike prices and expiration dates. The delivery months are the same for live cattle options as they are for live cattle futures contracts. (February, April, June, August, October and December). Once the live cattle futures price is determined in the pits of the exchange, the at-the-money option strike price is determined by selecting the closest even number to the futures price.

Seven strike prices are traded once the futures contract is listed as traded, one at-the-money and three above and three below the at-the-money option. The strikes are set on even numbers only. As

the market moves up or down, additional strike prices are made available for trading. Consequently, only the premium varies once the option is listed as available for trading.

Option Pricing

Black and Scholes (1973) developed a theoretical model for pricing stock options. Black (1976) later extended this model for use in determining premiums of options on futures contracts. Black's model suggests that commodity option premiums are a function of (1) volatility of the underlying commodity, (2) time until expiration of the option contract, (3) the strike price of the option, (4) the current commodity futures price and (5) the prevailing interest rate on a risk-free investment. Because this model is relatively simple and easy to calculate, it is used extensively by many trading houses and by traders in the pits of the exchange. To draw a greater understanding of the Black model, one must first understand how each of these five variables effects the value of the option.

Volatility Of The Underlying Commodity

Market volatility is a term that refers to the degree of variability in the price of the commodity that underlies an option. In other words, volatility is the degree of price change over time. Volatility may be measured by the changes in the commodity price from month to month, from week to week, or from day to day and represents the stochastic or unknown factor associated with a commodity. It is

only where there is some chance that the commodity price will move into-the-money that there will be any interest whatsoever in buying an option. Therefore, the greater the volatility, the greater the chance of the commodity price moving into-the-money and the greater the option premium.

Time To Expiration Of The Option Contract

Time to expiration is defined as the time between the present date and the expiration date of the option. Option premia are often referred to as being equal to the intrinsic value of an option plus its time value. Therefore, the value of an option premium is directly related to its time value. As an option approaches expiration, its time value declines until expiration, when the option's intrinsic value is equal to its total value. Figure 9 shows that the more time remaining in an option prior to expiration, the greater will be the premium.

This phenomenon may be attributed to the fact that the insurance value of an option decreases as it approaches expiration. The insurance value is greater when the option term is longer because there is more possibility that adverse events will occur during a longer time period.

By extending the life of the option, one extends the period over which one enjoys the insurance value. This is shown by the call option price curve shown in figure 10.

The call option price curve is a curve that plots the premium of a call option against the underlying commodity futures price (S^*). A

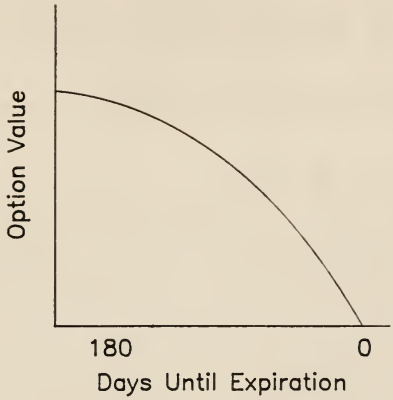

Figure 9. Declining time value of an at—the—money option

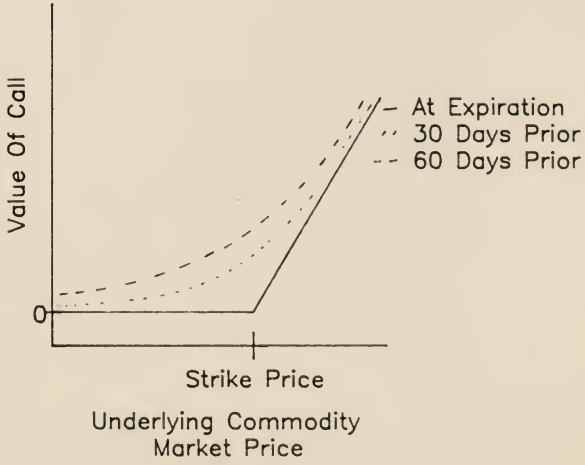

Figure 10. Value of a call option at different points in time

similar curve can be derived for put options as well. As is shown graphically in figure 10, as the time to expiration is extended from 30 days to 60 days, the premium associated with the extended time value increases. The time value portion of the premium is greatest when the futures price and the strike price are the same. When the option is very near its expiration, the option trades for nearly its intrinsic value and there is said to be no time value left in the option.

Underlying Commodity Price And The Strike Price

The relationship between the price of the underlying commodity and the strike price impacts tremendously on the price of the option. The strike price designates the specific price at which an option writer incurs an obligation to an option holder. A put writer has a potential obligation to buy a futures contract, and a call writer has an obligation to sell a futures contract. The strike price of an option also allows for distinguishing between "in-the-money" and "out-of-the-money" options.

Out-of-the-money call options are defined as those option series with a strike price above that of the current market value of the underlying commodity. Out-of-the-money put options are those series with a strike price below that of the current market price of the underlying commodity. For example, if the current market price of a June live cattle futures contract is $58/cwt., then all contract series with a strike price above $58/cwt. would be an out-of-the-money call option. All contract series with a strike price below $58/cwt.

would be termed out-of-the-money put options.

In-the-money call options are those contract series in which the current market value of the underlying commodity is above the strike price. In-the-money puts have a strike price above the current market price of the underlying commodity.

The strike price can be used to determine the intrinsic value of an option. The intrinsic value of an option is the absolute difference in dollar amount between the market price of the underlying commodity and the strike price of the contract series. For example, if October live cattle were currently trading at $60/cwt. and an October live cattle call option had a strike price of $58/cwt., then the intrinsic value of an in-the-money call option would be as follows:

Current market price - call option price = intrinsic value.

$60/cwt. - $58/cwt. = $2/cwt. = intrinsic value.

Only in-the-money puts and calls have intrinsic values due to the favorable market price of the underlying futures. In-the-money options can be exercised or sold at a favorable profit by the holder. Fortunately, the relationship between the underlying futures price and the strike price is directly observable. We know that an option premium may be a good deal greater than the intrinsic value; this excess over and above the intrinsic value represents the time value of the option.

Short-term Interest Rates

The prevailing short-term interest rate affects the rate of

return on any investment as interest rates are a measure of the cost of money. A reasonable return is expected because there are alternate opportunities available to an investor. The return expected equals the return foregone on an alternate investment with the same risk profile. A risk-free interest rate is used to represent the opportunity cost of capital and short-term Treasury bills are used to measure the risk-free interest rate.

Holding all other variables in the option pricing formula constant, if the interest rate rises, the option premium will fall. An increase in the interest rate reduces the present value of the exercise price of the option. Since the exercise price is a potential liability to the option writer, this increases the value of the option. On the other hand, anything that increases the value to the writer, decreases the value to the holder. Therefore, knowledgeable traders will offer less premium to purchase the option. Also, as interest rates increase, alternate investments become more attractive to prospective buyers. Consequently, money is channeled away from the options markets and the premiums fall.

In order for the option to yield a rate of return (r) over the time until expiration (t), the option premium must be discounted by a factor of $1/(1+r)t$. Because commodity prices are assumed to change continuously, we may assume that interest is compounded continually. Therefore, based on these assumptions, we must discount by a factor of e^{-rt}, where e is the base of the natural logarithm.

THE BLACK MODEL

Based on the assumptions that the underlying commodity futures price is distributed log-normally and that the variance of the relative price changes is constant during the option contract's life, Black determined that these variables can be combined to form a theoretical option pricing formula. The valuations for call (C) and put (P) options on futures are:

$$C = e^{-rt} [S\ N(d1) - X\ N(d2)]$$

$$P = e^{-rt} [S\ N(-d1) - X\ N(-d2)]$$

where $d1 = [\ln(s/x) + (v^2t)/2]/vt^{1/2}$

$d2 = [\ln(s/x) - (v^2t)/2]/vt^{1/2}$

N = normal cumulative probability distribution of the underlying commodity prices

r = prevailing risk-free interest rate

t = time to expiration

S = futures price

K = strike price

v = variance of the underlying commodity prices and

ln = natural logarithm.

We can define the value of a call on its expiration date as $C^* = \max[0, S^* - K]$. S^* is defined as the futures price at expiration. If $S^* > K$, the call is said to finish "in-the-money" and the value would be $(S^* - K)$. If $K > S^*$, the call is said to finish "out-of-the-money"

and the value of the call would be zero. If $S^* = K$ the call finishes "at-the-money" and again the call would be valued at zero.

These same symbols can be used to represent a put on its expiration date. Letting P^* represent this value, the symbolic value of a put at expiration is $P^* = \max[0, K - S^*]$. In this case if $S^* < K$ then the put finishes "in-the-money" and the value would be equal to $[K - S^*]$. Also if $S^* > K$ or $S^* = K$, the put would finish "out-of-the-money" and "at-the-money" respectively, and the value would be equal to zero.

The profit and loss implications of an option position are often confusing, so payoff diagrams of an option held to expiration will be used to help understand the concepts. The most elementary payoff diagram describes a long position in the underlying commodity. Figure 11 shows a payoff diagram illustrating a long position in the underlying commodity (ignoring commissions, margin and taxes).

If the futures price on the final date is equal to zero ($S^* = 0$), then a long commodity position will have realized a net loss of S, where S is the current futures price. The position will result in no profit or loss if $S^* = S$ on the final date. Net profit in a long futures position will equal $(S^* - S)$. As shown in figure 11, a \$1/cwt. increase or decrease in S^* will result in a \$1/cwt. increase or decrease in net profit, respectively. Similarly a short position can be represented in the same manner. With the long position, the possible loss is limited to S, while the possible gain is virtually unlimited. With a short position, the possible gain is limited to S, while the loss is relatively unlimited.

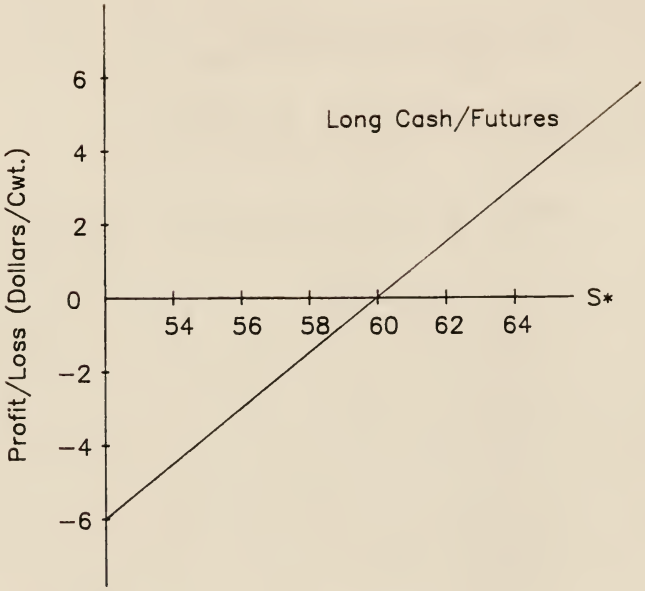

Figure 11. Long cash/futures

Figures 12, 13, 14 and 15 show the profit-and-loss implications of the four basic option trading strategies. As figure 14 shows, a purchased call is similar to a long position in the underlying commodity except that it insures against extreme upward movements in the futures price. In the same manner, a purchased put is similar to a short position in the underlying commodity, except it offers protection against extreme downward movements in the futures price. However, the insurance provided by options comes at a price known as

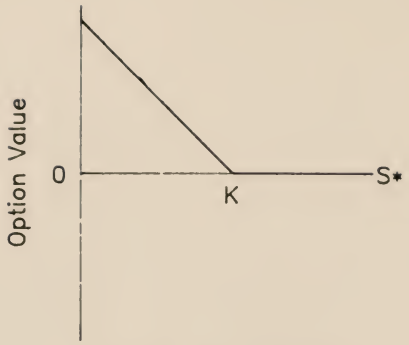

Figure 12. Long put

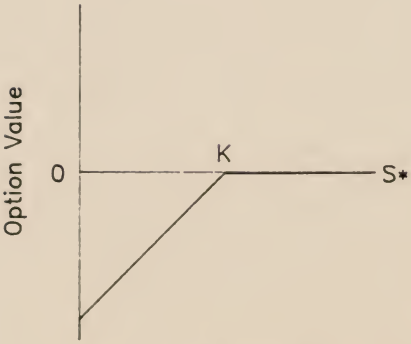

Figure 13. Short put

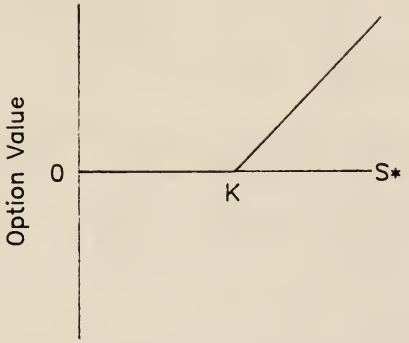

Figure 14. Long call

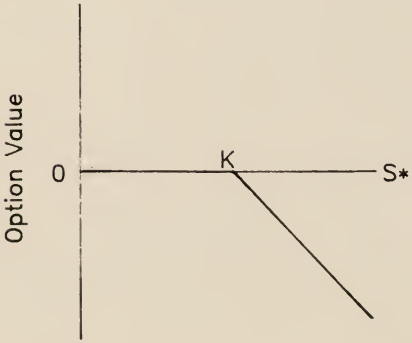

Figure 15. Short call

the premium.

To further illustrate this point, suppose the current futures price S is equal to the strike price K on its expiration date, so $S^* = S = K$. While a long or short position in the underlying commodity would show a zero net profit, a purchase of a put or call would result in the loss of the entire investment, the option premium paid. The payoff diagrams illustrate an important point: the options market is a zero-sum game. That is, the option buyer profits at the option writer's expense, and vice versa.

Option Strategies

The flexibility offered by puts and calls becomes evident when combined positions are considered, such as buying a put against a long position in the underlying commodity. These types of positions are considered "covered" positions. A covered position results when a call or put option is bought or sold in conjunction with a position in the underlying commodity. A covered position can take one of three forms; 1) a hedge, 2) a spread or 3) a combination.

In this study only two of these strategies are considered, hedges and spreads. A hedge combines an option with its underlying commodity in such a way that either the commodity protects the option or the option protects the commodity from a loss.[1] A hedge, as defined here, combines one to one a long position in the commodity with either a purchased put or a written call. The most popular cattle hedge consists of writing one call or purchasing one put against each 40,000 lbs. of cattle to be sold.[2] This is known as a one to one hedge.

Figures 16 and 17 show the payoff diagrams for these positions. The net payoff line for the combined position is determined for each value S^* of the commodity at expiration, by adding together the vertical distances of the two separate payoff lines from the horizontal axis.

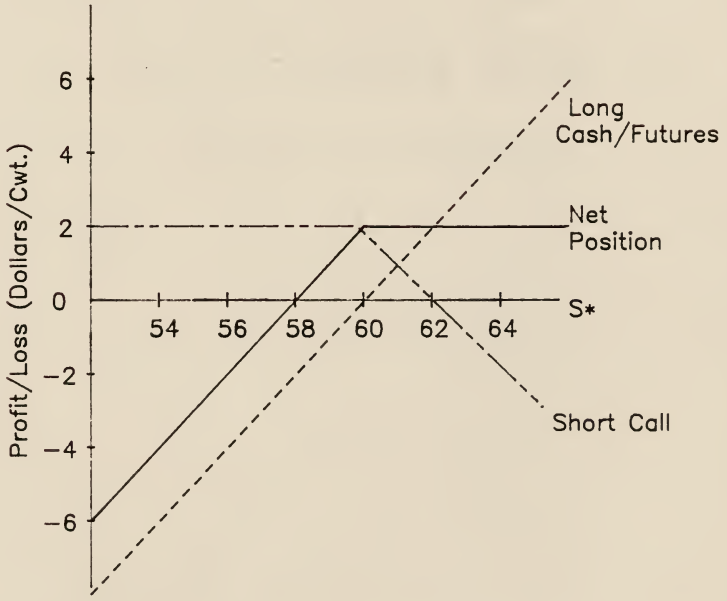

Figure 16. Long cash plus short call

Figure 16 shows a payoff diagram of a written call with a $60/cwt. strike price for a $2/cwt. premium combined with a long live cattle futures position at $60/cwt. The net position line shows a breakeven point at $58/cwt. This results because a $2/cwt. premium was received from writing the call. As the futures price at expiration falls below $58/cwt. the net loss received is $2/cwt. less than it would have been if a long cash cattle position would initially been taken. If the price of the futures at expiration was between $58/cwt. and $60/cwt., the holder of this position would realize a net profit of exactly the difference between the futures price and $58/cwt..

For example, if the futures price was $59/cwt. at expiration, the holder would receive a $1/cwt. net profit ($59/cwt.-$58/cwt.), ignoring commissions, margins and taxes. As the futures price rises above the $60 strike price, the greatest net profit that can be realized is $2/cwt. or $800 per contract. This ceiling price occurs because as the futures price rises above the $60/cwt. strike price an equal and offsetting loss is occurring in the option position. The difference between the two is the $2/cwt. premium received for writing the call.

Figure 17 shows the hedge of a long live cattle futures position at $60/cwt. and a long $60/cwt. live cattle put. A $2/cwt. premium was paid for the put.

As the futures price rises above $62/cwt. the net profit is $2/cwt. less than if a long position was taken in the futures only. The difference being the $2/cwt. premium. If the futures price at

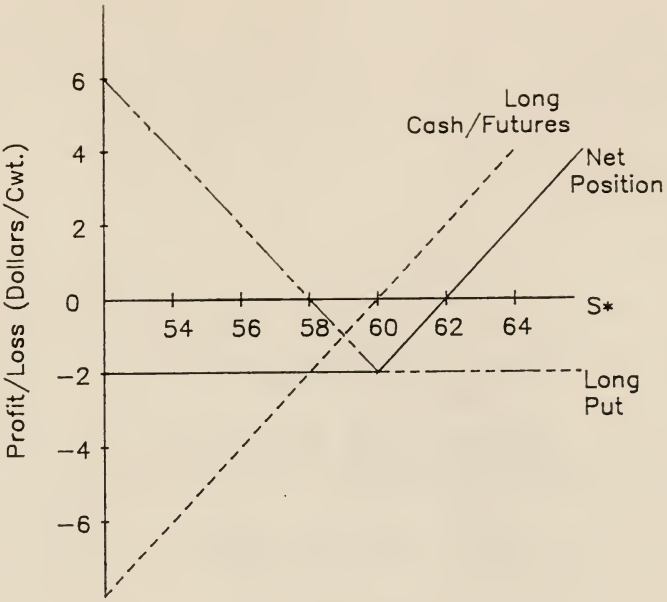

Figure 17. Long cash plus long put

expiration is between $62/cwt. and $60/cwt. the net loss would be the difference between $62/cwt. and the futures price. To illustrate, if the futures price at expiration was $61/cwt. the net loss would be $1/cwt. ($62/cwt. - $61/cwt.). As the futures price falls below the $60/cwt. strike price, a price floor is established with the maximum net loss of $2/cwt. or $800 per contract. This occurs because as the futures price falls below $60/cwt. an equal and offsetting profit is made on the long put. Thus, a price floor is established.

A spread is a transaction in which one simultaneously buys one option and sells another option on the same underlying commodity. The

logistics behind a spread is that the investor uses the sale of one instrument to reduce the risk of buying the other. We will evaluate three vertical spreads, the bear put spread, the bear call spread and a spread combining calls and puts (fence).

Bear Call Spread

A vertical bear call spread consists of buying a call with a higher strike price and writing a call with a lower strike price than the current underlying futures price. Figure 18 shows a payoff diagram of this spread.

This type of spread is called a credit spread. Calls trading at lower strike prices always trade at higher premiums than calls trading at higher premiums if both calls have the same expiration date. Since the lower strike is sold and the higher strike is bought, a net credit position is realized.

The bear call spread tends to be profitable if the underlying commodity declines in price, but has limited profit and loss potential. The maximum possible profit on the transaction is equal to the net difference between the two premiums. The maximum loss possible is equal to the difference between the two strike prices minus the difference between the two premiums. The greatest profit would occur if prices decline to the strike price of the short call. The maximum loss of the spread would occur if prices rise above the strike price of the long call.

Figure 18 shows that the credit position of selling a $58/cwt. call for $3/cwt. and buying a $64/cwt. call for $1/cwt.. In this case

the net position is $2/cwt. ($3/cwt. - $1/cwt.) with a break even price of $63/cwt.. The maximum loss from this option transaction is $4/cwt. (($64/cwt. - $58/cwt.) - ($3/cwt. - $1/cwt.)), while the maximum profit is the net premium received ($2/cwt.).

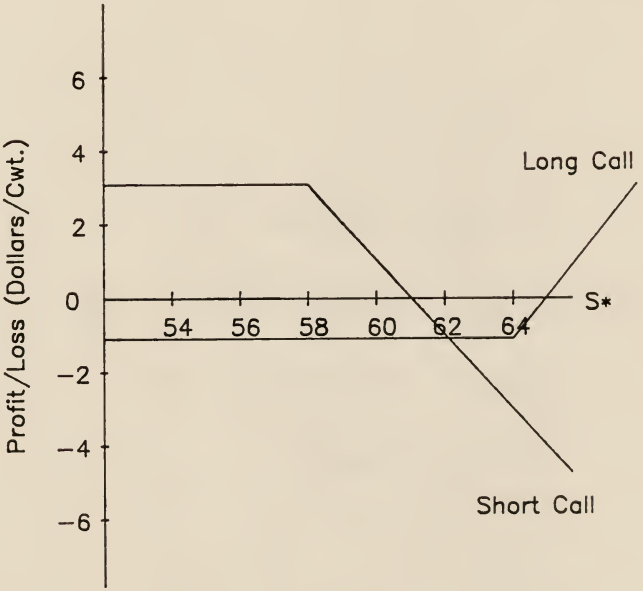

Figure 18. Bear call spread

Combining this with a long live cattle futures position gives a payoff diagram as shown in figure 19. As the price of the underlying commodity drops to the strike price of the short call, the producer loses on the actual commodity while the spread moves to maximum profit. When the futures price rises above the strike price of higher

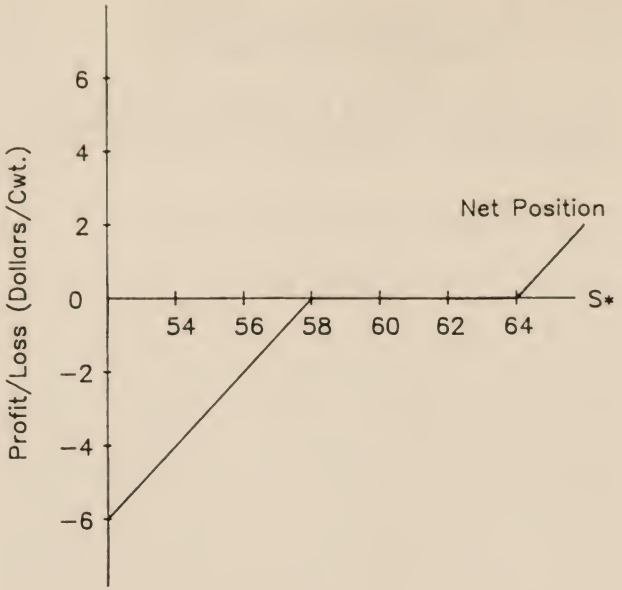

Figure 19. Bear call spread plus long cash

call, the gain received from the long futures position offsets the loss occurred on the option transaction. The break even point for this transaction is the lower strike price plus the net premium received, assuming no basis fluctuations. In this case it would be $60/cwt. ($58/cwt. + $2/cwt.).

Combining a call bear spread with a long futures position does not limit the profit/loss of the combined position because neither a ceiling nor a floor price is established. Instead, the combined positions act to reduce the loss/profit. Theoretically, this spread is traded to minimize losses.

Bear Put Spread

The put spread strategy does not differ greatly in theory from the call spread strategy. A bear put spread is constructed by selling a put with a lower strike price and buying a put with a higher strike price than the current underlying futures price. This is a vertical spread as was the bear call spread. Figure 20 shows a payoff diagram for the bear put spread combined with a long cash position.

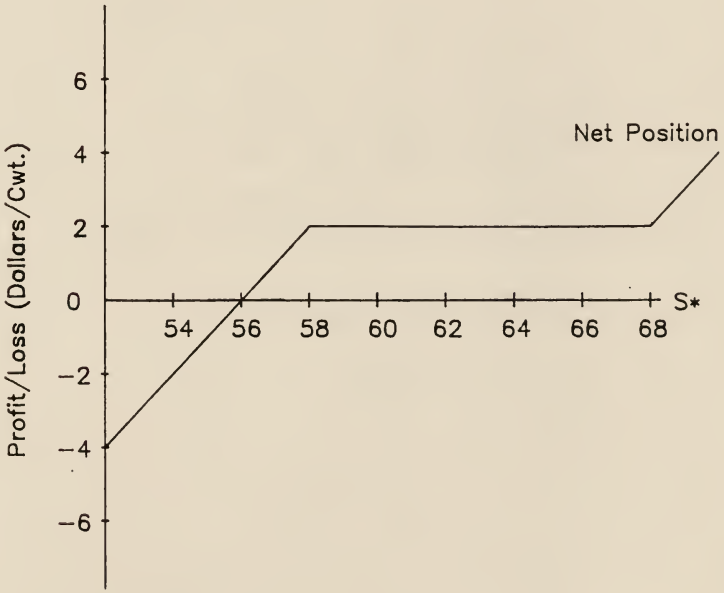

Figure 20. Bear put spread plus long cash

Referring to figure 19 shows that the bear put spread combined with a long futures position has a very similar payoff diagram as the bear call spread. In fact, given the proper situation, the profit/loss profile on this spread could be exactly equivalent to the bear call spread discussed previously. The maximum profit on the spread occurs if the futures price declines to the lower strike price and is equal to the difference between the two strike prices minus the difference between the premiums. The maximum loss on the spread occurs if the futures price rises above the higher strike price. The loss is equal to the difference between the premium paid for the long put and the premium received for the short put.

Notice that this is a net debt position as premiums for puts with higher strike prices are higher than the premiums for puts traded at lower strike prices. Therefore, if the put with the higher strike is bought and the put with the lower strike is sold, the net position is a debt position. The spread breakeven point is the higher strike price less the net premium paid.

This spread minimizes losses in the same manner as the bear call spread. Assuming no basis fluctuations, if the commodity price falls below the spread breakeven point, $58.00/cwt., the spread is in a profit position as the underlying commodity is in a loss position. Once the futures price falls below the lower strike price, losses on the total position would be equal to the loss on the futures transaction less the premium profit on the spread.

Fence Spread

A fence spread is created by trading both calls and puts with the same expiration date. A short hedger establishes a fence by going long a put and writing a call. The long put establishes a price floor to protect against a price decline and the short call position creates a price ceiling. This position can be a net credit, debt or neutral position depending on the strike prices chosen for the spread. For example, if a put with a high strike price is bought the producer should expect to pay a high premium. Therefore, to offset this, a call with a low strike price should be sold because these calls sell for a high premium as well.

Figure 21 shows a diagram of a long put and short call with the same strike price and expiration date. Notice that this payoff diagram is exactly the same as that of a short futures position. In fact, this spread strategy is termed a synthetic short futures position.

Figure 22 shows the net payoff diagram of a fence combined with a long futures position. The fence is created by selling a $62.00/cwt. call for $2.00/cwt. and buying a $58.00/cwt. put for $2.00/cwt. Notice how the floor price is created by buying the put. This way the producer is protected from any downside price movement. On the other hand, the price ceiling is created by the sale of the call. This prohibits the producer from realizing any windfall profits. A fence creates a zone of possible hedging prices between the ceiling and floor prices.

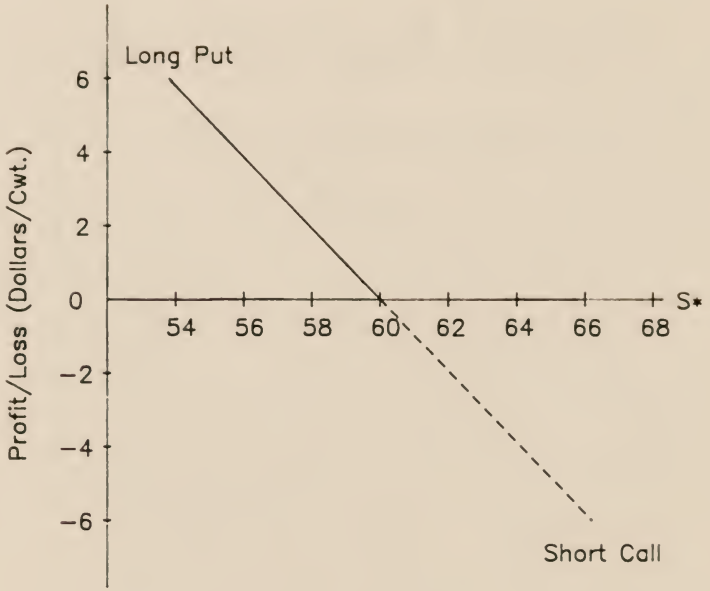

Figure 21. Long put plus a short call with the same strike price

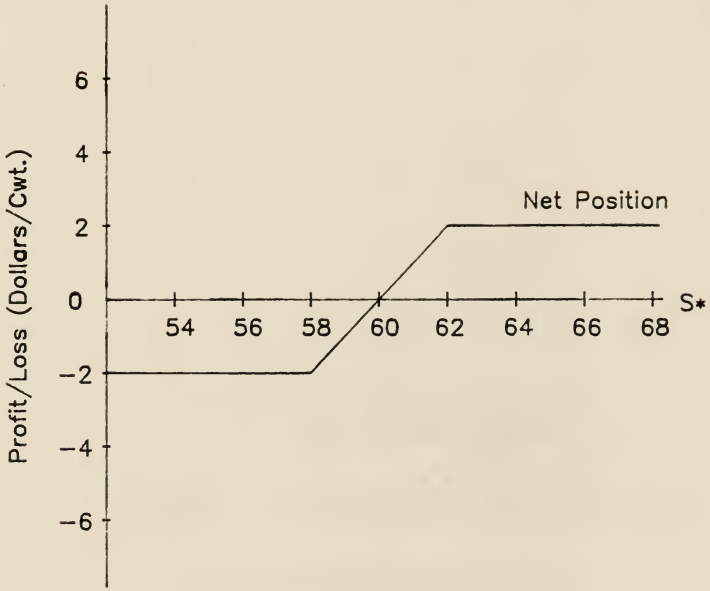

Figure 22. Fence plus long cash

Notes

1. Selling a call option is not technically a hedge because it does not protect the cash market from a loss. A call will be sold to earn additional income or achieve an above-the-market selling price.

2. Information was obtained by dialogue with local commodity brokers.

CHAPTER IV

METHODOLOGY

The performance of short hedge strategies for cattle placed on feed from January, 1980 to December, 1985 were simulated through calculating average net returns and net return variability. Actual data from 1600 pens of steers were obtained from a western Kansas commercial feedyard for the six year period. The actual data included feeder cattle weights and shrink, total feeding costs, death loss, health costs, processing, fed cattle weights and shrink, fed cattle selling prices and returns to labor and management (Apendix A).

Feeder cattle costs and interest on production were estimated. Feeder cattle prices were obtained by using the Dodge City, Kansas, weekly average feeder cattle prices for 600-700 pound and 700-800 pound feeder cattle.[1] The prevailing prime interest rate at the time the cattle were placed on feed was used to calculate interest expenses on the total cost of the feeder cattle and one half of the feed costs for the feeding period.[2] No transportation costs were included when the cattle were delivered to the yard or shipped to the slaughter house.

Profits on pens of cattle that were put on feed in one year and sold in the next were accounted for in the year the cattle were placed on feed. It was assumed that the data was from a single owner feedyard whose only source of income was from feeding cattle. Therefore, any money not being utilized in the cattle feeding operation was held in a non-interest bearing account until it was used

to purchase the next pen of cattle. In addition, the data was not normalized to remove any seasonallity of placements that may have occured.

Futures prices were Chicago Mercantile Exchange (CME) daily closing prices for the live cattle contract.[3] Option premia were estimated using Black's model for option premia on futures contracts.[4] The return on 90-day U.S. Treasury Bills[5] was used to estimate the short term risk-free interest rate and a constant volatility of .15 was used in Black's model.[6] Under current CME rules, the months of February, April, June, August, October and December are designated as delivery months; consequently, futures and options contracts are only traded for these months.

Cattle sold on and between the 1st and 20th of a delivery month were hedged in that month. Cattle sold during a non-delivery month or sold after the 20th of a delivery month were hedged using the contract of the delivery month nearest to but after the feeding period for both futures and options hedges.

All hedges were routine in that they were placed the day the cattle were put on feed and lifted the day the cattle were sold. If cattle were bought and sold on days that the CME was not trading, weekends and holidays, the hedges were placed or lifted on the nearest preceeding business day.

The number of futures and option contracts bought or sold was determined by dividing the selling weight of the cattle by 40,000 pounds and rounding to the nearest whole number. Therefore, some pens of cattle were overhedged and some underhedged.

Futures trading commissions used were $60 per contract per round turn with an $800 per contract initial margin deposit. One-way option hedging commissions were $30 per contract with an $800 per contract margin deposit if the option was initially sold.[7] An opportunity cost was calculated and included in the hedging costs for margin deposits and for premia paid for futures or option contracts. The current risk-free interest rate at the time the trade was initiated was used to estimate the opportunity cost. There were no margin calls if the market moved against the board position.

Strategies Evaluated

Short futures, writing call and buying put hedges as well as bear call spreads, bear put spreads and fences were evaluated along with an unhedged cash sale. Each strategy is briefly explained.

The net return for the unhedged cash sale was simply the per head receipts less the per head cost of production.[8] Net returns to routine futures hedging were calculated by summing the cash profit (loss) for the sale of the cattle and the profit (loss) from the futures transaction. The profit (loss) from the futures transaction was the difference between the premium received (paid) and the premium paid (received) less commissions and the opportunity cost of the margin deposit.

Seven call writing strategies were evaluated, each at a different price. An at-the-money call option was determined by selecting the CME closing price for the relevant delivery month and rounding to the nearest even number. In addition to the at-the-money strategy, three

in-the-money and three out-of-the-money strategies were evaluated. The out-of-the-money strategies involved selling calls at three,two dollar intervals above the at-the-money option. The same procedure was used for the three in-the-money strategies. Therefore, if the strike price of the at-the-money option was $60/cwt., calls were also sold at $54, $56, $58, $62, $64 and $66/cwt..

In this study, the written call could only be offset or allowed to expire the day the cattle were sold. None of the option contracts were exercised. The call option was offset if the premium paid by offsetting was greater than the commissions incurred by offsetting ($30 per contract), otherwise the option was allowed to expire.

The net return for the call strategies was calculated by summing the cash cattle sales profit (loss) with the option transaction profit (loss). The net return for the option transaction was the difference between the net premium received when the call was sold and the net premium paid when the option was offset less commissions and interest on the margin money. If the call expired, the net return equalled the net premium received when the call was sold less commissions and interest on the margin deposit.

Seven put buying hedging strategies were also evaluated. The seven strategies consisted of one at-the-money, three in-the-money and three out-of-the-money strategies. The strike prices were determined in the exact manner as the call strategies. The put options were also only allowed to be offset or expire. The options were offset if the premium received when the option was to be offset was greater than the commissions that resulted from offsetting ($30 per contract).

The calculated net return for the put option strategies was the cash sales price for the cattle plus (minus) the option transaction profit (loss). The net return for the option transaction was the difference between the premium received, if offset, and the premium paid for the option when it was bought less commissions and the opportunity cost of the premium.

Similar tactics were used to evaluate three different option spreads, each with three different widths. If the strike price of an at-the-money option was $60/cwt. the day the cattle were placed on feed, the seven strike prices evaluated for that option would be $54, $56, $58, $60, $62, $64 and $66/cwt.. Figure 23 illustrates the construction of the spreads.

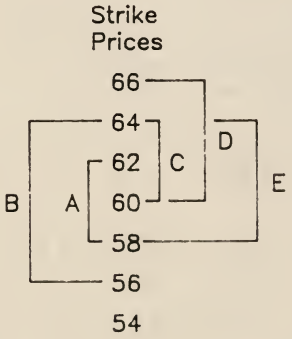

Figure 23. Spread design

Spread A would have a four dollar width ($62-$58=$4) as would spread C. Spread B would have an eight dollar width while spreads D and E have six dollar widths. The three spreads were chosen based on

a logical tradeoff of the insurance protection provided by the spread and the magnitude of the premia involved.

Vertical call spreads were simulated by selling an appropriate number of calls with a higher strike price and buying the same number of calls with a lower strike price. In figure 23, spread A would be constructed by selling a $62.00/cwt. call and buying a $58.00/cwt. call. The remainder of the spreads, B, C, D and E were built using the same format. The call options in the spreads were only allowed to be offset or expire under the same rules for the previous call option strategies.

Each spread is identified symbolically by its type and width. The bear call spreads are identified as "calsp". The numbers signify the relative position from the at-the-money option. From figure 23, spread E is represented by the name "calsp 42". The number "42" indicates that a $4.00 out-of-the-money call was sold and a call $2.00 in-the-money was bought. The number 0 symbolizes the at-the-money option. In the same manner spread A is termed calsp 22, spread B equals calsp 44, spread C equals spread 40, spread D equals calsp 60 and spread E equals calsp 42.

The vertical put spreads were manufactured in three different widths by buying a put with a higher strike price and selling a put with a lower strike price. The symbols used to identify the put spread are as follows: spread A is putsp 22, spread B is putsp 44, spread C is putsp 40, spread D is putsp 60 and spread D is putsp 42.

Additionally, the fences were simulated by selling calls with a higher strike price and buying puts with a lower strike price. The

fences are identified using the same format as the other spreads. Spread A is identified as fence 22, spread B as fence 44, spread C as fence 40, spread D as fence 60 and spread E as fence 42.

The net returns of the spread hedges were calculated by the addition of the cash cattle profits (losses) and the spread profits (losses). The net return of the spreads was calculated using the same format as that of the previous call and put option strategies.

Statistical Procedures

The average return and variance of the returns for the unhedged cash sales and for each of the 30 hedging strategies was determined for the entire six year period and for each of the six years individually. The null hypothesis tested was that the average return and variance for the unhedged cash sales and for each of the hedging strategies were equal.

The statistical procedure used to test the null hypothesis was obtained from Ashley, et al.(1980). Letting M_c and V_c represent the mean return and variance of returns for cash sales and M_h and V_h the mean return and variance for the hedging strategy, then $d_1 = (M_c - M_h)$ and $d_2 = ((M_c + M_h) - \sum_{i=1}^{n} (M_c + M_h)/n)$, where n is the number of observations. By regressing d_1 on d_2 for each hedging strategy, the following equation results: $d_1 = B_1 + B_2(d_2)$. If B_1 was positive and significant, $P < .05$ using a standard t-test, then the mean cash return was greater than the mean return for the hedging strategy being tested. If B_1 was negative and significant, then the hedging mean return was greater than that of cash.

In the same manner, if B_2 was positive and significant ($P < .05$), then the variance of returns associated with cash sales was greater than the variance of the hedging strategy being tested. Intuitively, if B_2 was negative and significant, then the variance of cash sales was less than that of the hedging strategy.

Notes

1. Feeder cattle prices were obtained from the Winter Livestock Feeder Cattle Auction, Dodge City, Kansas.

2. Federal Reserve Bank of Kansas City, Economic Review.

3. Chicago Mercantile Exchange, Chicago Meacantile Exchange Yearbook.

4. The source of Black's option pricing model for option premia on futures contracts was "Discover Your Options" copyrighted by The Chicago Mercantile Exchange, 1985.

5. United States Department of Commerce, Bureau of Economic Analysis, Business Conditions Digest.

6. Schroeder (1986) compared the historical volatility of the CME live cattle futures prices to the actual implied volatility for 1985, using four different historical time series. The four historical time series were: 1) the previous year, 2) the previous three years, 3) the previous three months and 4) the previous one month prior to the initiation of the option contract. He shows that the three years' volatility estimates most closely resembled that of the actual implied volatility. He also shows that the range of the three year historical volatilities was between 12.60 and 16.06, therefore, a volatility of .15 is used in this study.

7. Commissions and margin deposit ammounts were obtained from a local commodity broker and are consistant with current literature.

Notes, continued

8. All data were stored on Lotus 1-2-3 worksheets. All calculations were estimated by formulas entered into the spreadsheets. Formulas used to derive returns are exhibited in Appendix B.

CHAPTER V

RESULTS

Thirty hedging strategies were simulated and compared with an unhedged cash strategy based on actual data collected from a 30,000 head one time capacity commercial feedlot in western Kansas. The results are reported as a summary for the entire time period and then segmented into individual years.

Figure 1, in Chapter I, shows that the Dodge City, Kansas, cash cattle prices for the 1980 to 1985 period were cyclical but sideways trending. Slaughter cattle prices ranged from $44.50/cwt. to $75.50/cwt. with an average of $64.29/cwt. The average cost of gain was $0.54 per pound and the average breakeven was $63.00/cwt.. The average weight of cattle placed on feed was 735 pounds, the average weight when sold was 1147 pounds and the cattle averaged 138 days on feed (Appendix C). Average returns per head from feeding steers during this time period was $11.17 with a standard deviation of $62.56 (Table 1). In addition, all 30 hedging strategies produced positive mean returns for the six year period.

Four of the thirty hedging strategies produced mean returns that were slightly, but not significantly, higher than that of cash and also reduced the variance of returns. The four strategies were: 1) short futures hedges, 2) selling at-the-money call options, 3) buying put options $4 in-the-money and 4) buying put options $6 in-the-money at the time of cattle placement.

Table 1. Net Returns per Head and Variance of Returns for Hedging Strategies, Average for 1980-1985[a]

Strategy	Mean	Standard Deviation	Minimum Value	Maximum Value
Cash	11.17	62.56	-262.28	222.86
Hedge	12.52	37.93*	-152.95	215.36
Call +6	10.64	54.06*	-242.71	226.90
Call +4	10.85	50.59*	-233.67	232.02
Call +2	11.03	47.24*	-222.16	239.71
Call 0	11.39	44.20*	-207.78	250.68
Call -2	10.94	41.67*	-190.52	244.46
Call -4	10.09	39.92*	-174.49	233.12
Call -6	9.17	38.72*	-157.23	225.07
Put +6	12.12	38.69*	-165.51	215.36
Put +4	11.27	39.66*	-156.57	209.95
Put +2	10.42	42.23*	-164.61	201.46
Put 0	9.35**	45.31*	-179.46	198.85
Put -2	9.38*	49.24*	-197.74	208.21
Put -4	9.28*	53.07*	-217.88	214.76
Put -6	9.95*	56.21*	-236.44	218.50
Calsp 22	5.48*	75.51*	-300.39	240.27
Calsp 44	5.47*	88.26*	-331.34	278.56
Calsp 40	6.62*	74.01*	-286.09	247.82
Calsp 60	6.40*	79.91*	-295.13	281.85
Calsp 42	5.30*	82.00*	-311.90	265.98
Putsp 22	4.31*	76.30*	-303.77	240.88
Putsp 44	2.66*	89.58*	-337.47	278.85
Putsp 40	2.73*	75.73*	-299.05	247.65
Putsp 60	1.33*	81.46*	-309.74	280.18
Putsp 42	2.76*	82.95*	-317.33	266.03
Fence 22	9.23**	36.39*	-158.62	213.54
Fence 44	8.95*	40.94*	-190.27	215.86
Fence 40	9.02*	36.45*	-151.85	200.40
Fence 60	8.81*	38.08*	-160.89	195.27
Fence 42	9.05*	38.10*	-170.13	205.85

[a] 1600 observations
* Significantly different from cash at P < .01
** Significantly different from cash at P < .05

Routinely placing futures hedges produced a mean return of $12.52 per head which is higher than that of cash marketing, while the variance of returns was reduced by 39 percent. Selling at-the-money calls produced a mean return of $11.39 per head and reduced the standard deviation by 29 percent. As the calls moved into-the-money mean returns and the variances of the returns reduced. As the call options moved out-of-the-money the returns were reduced but the variances increased as compared to the at-the-money call.

All seven of the put hedging strategies significantly reduced the standard deviation of returns compared to cash marketing. The at-the-money put reduced the mean return to $9.35 per head with a standard deviation of $45.31. As the puts moved into-the-money the mean returns increased and the variance decreased. Buying puts that were $4 and $6 in-the-money produced returns that were slightly higher than the cash returns. As the puts moved out-of-the-money the mean returns decreased and the variances of returns increased.

All bear call and put spreads significantly reduced returns while increasing the variance of returns. The range of mean returns for the fence spreads was $8.81 to $9.23 per head. These were significantly lower than the cash mean return. The variance of returns was lowered considerably by routinely placing fence spreads.

1980

In 1980, slaughter cattle prices ranged from $55.00./cwt. to $73.00/cwt with an average of $67.10/cwt. for the year. The average breakeven price was $68.00/cwt (Appendix C). Consequently, the mean

Table 2. Net Returns per Head and Variance of Returns for Hedging Strategies, Average for 1980[a]

Strategy	Mean	Standard Deviation	Minimum Value	Maximum Value
Cash	-5.09	67.53	-183.25	161.24
Hedge	21.88*	31.26*	- 91.21	99.61
Call +6	-0.36*	62.21*	-172.71	129.66
Call +4	1.44*	58.90*	-166.34	116.51
Call +2	3.91*	54.81*	-158.38	110.22
Call 0	6.76*	50.25*	-147.23	109.31
Call -2	9.00*	45.70*	-134.81	104.16
Call -4	11.23*	41.21*	-123.89	98.32
Call -6	12.74*	37.27*	-132.36	99.32
Put +6	16.65*	34.81*	-151.15	124.85
Put +4	12.74*	34.01*	-156.57	110.23
Put +2	9.95*	36.47*	-160.82	123.11
Put 0	6.56*	40.31*	-161.40	135.02
Put -2	3.47*	45.12*	-158.33	144.26
Put -4	0.47*	50.30*	-155.69	150.81
Put -6	-1.98*	55.38*	-171.54	155.28
Calsp 22	-16.23*	80.85*	-212.41	177.76
Calsp 44	-21.69*	94.35*	-236.72	209.17
Calsp 40	-13.93*	77.78*	-201.75	183.92
Calsp 60	-15.73*	82.28*	-208.12	205.33
Calsp 42	-18.70*	86.75*	-220.37	198.55
Putsp 22	-18.02*	81.63*	-215.97	178.11
Putsp 44	-24.56*	95.11*	-242.00	207.50
Putsp 40	-18.46*	80.03*	-212.39	183.14
Putsp 60	-22.00*	84.44*	-219.71	201.74
Putsp 42	-21.56*	87.51*	-225.52	196.96
Fence 22	12.48*	34.15*	-142.27	85.78
Fence 44	7.01*	41.43*	-142.10	106.09
Fence 40	13.10*	33.84*	-149.42	90.30
Fence 60	11.30*	35.80*	-152.56	103.44
Fence 42	10.01*	37.05*	-146.35	99.53

[a] 284 observations

* Significantly different from cash at $P < .01$

return for the unhedged cash sales was -$5.09 per head with a standard deviation of $67.53 per head (Table 2).

Hedging with futures dominated all strategies with a mean return of $21.88 per head with a standard deviation of $31.26. All of the call, put and fence spreads hedging strategies increased profitability and reduced the variance of returns over cash sales. Selling at-the-money calls produced a net return of $6.76 per head with a standard deviation of $50.25. As the calls moved into-the-money the profitability increased and the variance decreased. As the calls moved out-of-the-money the returns decreased and the variance increased. Selling calls $6 out-of-the-money sustained a loss of $0.36 per head.

Buying at-the-money puts realized a mean return of $6.56 per head with a standard deviation of $40.31. As the puts moved into-the-money the mean returns increased up to $16.65 per head for put options six dollars in-the-money. Also, the variance was reduced. As the puts moved out-of-the-money the returns decreased and the variances increased.

The call and put spreads produced greater losses and higher variances than cash sales. Fence spreads were successful in increasing profits over cash sales. The range of returns per head for the fences was $7.01 to $13.10. The two fences with $4.00 widths, fence 22 and fence 40, produced the higher returns and the lower variances of the fence spreads.

1981

In 1981, the cash market experienced sharp price movements but the trend was higher. Cash slaughter cattle prices ranged from $57.00/cwt to $74.50/cwt. with an average of $65.16/cwt. (Appendix C). The average breakeven price was $63.00/cwt. so the mean return for cash sales was positive, $19.40 per head. The standard deviation of cash sales, $47.35 was well below the average for the entire six year period, $62.56 per head (Table 3).

Futures hedging once again out-performed the cash market in both profitability and risk reduction. The mean return to futures hedging was $29.86 per head with a standard deviation of $34.54.

In general, selling calls was the leading option hedging strategy for increasing net returns. Selling the at-the-money call option produced a net return of $29.56 per head with a standard deviation of $31.52. The $2/cwt. in-the-money call selling strategy produced the highest net return, $30.78, and the lowest standard deviation, $30.33, of all marketing strategies. Selling calls $4/cwt. in-the-money ranked second in both profitability and risk reduction. The call option $6/cwt. in-the-money realized a net return slightly lower than the at-the-money call option. As the calls moved out-of-the-money, the net returns were reduced and the variance increased as compared to the at-the-money call option.

Buying $6/cwt. in-the-money puts was the most profitable and also realized the lowest variance of all the put buying strategies. The profitability decreased and the variance increased consistently as the puts moved from the deep in-the-money put to the deep out-of-the-money

Table 3. Net Returns per Head and Variance of Returns for Hedging Strategies, Average for 1981[a]

Strategy	Mean	Standard Deviation	Minimum Value	Maximum Value
Cash	19.40	47.35	-86.80	222.86
Hedge	29.86*	34.54*	-75.43	221.84
Call +6	21.89*	38.91*	-81.68	226.90
Call +4	24.13*	36.24*	-76.77	232.02
Call +2	26.91*	33.60*	-70.23	239.71
Call 0	29.56*	31.52*	-60.73	250.68
Call -2	30.78*	30.33*	-54.60	244.46
Call -4	30.22*	30.50*	-61.88	233.12
Call -6	28.65*	32.07*	-70.42	225.07
Put +6	27.10*	37.53*	-80.78	215.36
Put +4	24.13*	39.05**	-82.92	209.95
Put +2	20.50	40.88*	-96.57	201.46
Put 0	17.10	42.47*	-82.17	198.85
Put -2	15.02*	43.97*	-77.08	208.21
Put -4	14.65*	45.26**	-77.55	214.76
Put -6	15.30*	46.36	-85.66	218.50
Calsp 22	8.81*	57.03*	-112.69	240.27
Calsp 44	5.67*	66.68*	-130.53	263.34
Calsp 40	9.81*	55.91*	-102.72	246.80
Calsp 60	7.56*	60.19*	-107.63	265.72
Calsp 42	6.03*	61.86*	-119.24	256.79
Putsp 22	7.03*	57.97*	-117.13	240.88
Putsp 44	2.19*	67.69*	-136.61	262.74
Putsp 40	4.65*	57.71*	-113.12	246.83
Putsp 60	0.71*	62.09*	-119.34	264.25
Putsp 42	2.56*	62.99*	-125.64	256.19
Fence 22	22.45	32.35*	-71.20	213.54
Fence 44	19.30	34.22*	-68.92	215.86
Fence 40	21.75	33.74*	-76.92	200.40
Fence 60	19.51	35.12*	-76.92	195.27
Fence 42	19.67	33.75*	-71.83	205.85

[a] 296 observations
* Significantly different from cash at $P < .01$
** Significantly different from cash at $P < .05$

puts.

All of the call and put bear spreads reduced the mean return and increased the variance when compared to cash. In general, the fence spreads were the most successful at reducing risk in 1981. The standard deviation ranged from $32.35 to $35.12. The mean returns for all the fence spreads were not statistically different from the cash mean returns. The fence spreads with $4/cwt. widths produced returns slightly higher than that of cash sales.

1982

In 1982, cash prices rose steadily from around $60.00/cwt. in January to $75.50/cwt. in late May and then dropped sharply back to $60/cwt. by September. They remained around $60/cwt. for the rest of the year (Figure 4). The average cash price was $65.11/cwt. and the average breakeven was $62.00/cwt. (Appendix C). The mean cash return for 1982 was $33.16 per head with a standard deviation of $65.45 (Table 4). This standard deviation was slightly higher than that of cash sales for the entire six year period, $62.56 (Table 1).

Futures hedging produced a mean return ($2.01 per head) which was much lower than that of cash. In fact, futures hedging realized the lowest mean return of all hedging strategies in 1982. Also, the standard deviation was quite high at $51.44.

Call and put bear spreads increased the net returns over cash and were the top performers of all the marketing strategies as far as profitability. The spreads $8/cwt. in width realized the highest profitability but also showed the highest variability of all the call

Table 4. Net Returns per Head and Variance of Returns for Hedging Strategies, Average for 1982[a]

Strategy	Mean	Standard Deviation	Minimum Value	Maximum Value
Cash	33.16	65.45	-77.73	212.58
Hedge	2.01*	51.44*	-152.95	111.43
Call +6	23.66*	53.34*	-81.23	169.53
Call +4	20.30*	50.63*	-100.59	145.92
Call +2	16.48*	49.16*	-118.05	143.67
Call 0	12.94*	49.20*	-131.71	135.95
Call -2	8.85*	49.32*	-141.86	125.26
Call -4	5.45*	50.11*	-148.85	117.63
Call -6	2.77*	50.89*	-152.98	114.27
Put +6	10.20*	52.29*	-124.54	141.12
Put +4	13.23*	54.04*	-112.75	158.74
Put +2	16.31*	56.29*	-107.11	174.29
Put 0	19.66*	58.66*	-97.66	186.33
Put -2	23.07*	61.22*	-94.24	196.60
Put -4	25.63*	63.03*	-85.90	203.06
Put -6	28.24*	64.79*	-80.86	207.17
Calsp 22	35.19*	75.35*	-88.31	235.86
Calsp 44	41.81*	85.99*	-110.76	264.82
Calsp 40	35.88*	76.07*	-89.49	242.64
Calsp 60	39.24*	82.94*	-93.49	264.94
Calsp 42	39.00*	81.86*	-94.37	255.27
Putsp 22	34.68**	75.80*	-90.58	235.98
Putsp 44	39.62*	86.38*	-113.05	263.30
Putsp 40	33.64	77.42*	-92.76	242.09
Putsp 60	35.92**	84.05*	-97.99	262.48
Putsp 42	37.05*	82.63*	-98.25	254.40
Fence 22	6.39*	47.58*	-131.40	129.69
Fence 44	12.76*	48.43*	-107.75	138.26
Fence 40	6.79*	47.57*	-123.70	121.94
Fence 60	10.15*	48.52*	-104.33	139.38
Fence 42	10.20*	47.84*	-113.94	131.93

[a] 290 observations
* Significantly different from cash at P < .01
** Significantly different from cash at P < .05

and put bear spreads. While these spreads were the most profitable, they also produced the highest standard deviations of all the marketing strategies.

Selling call options reduced the variability of income but also reduced the net returns when compared to cash sales. Selling at-the-money calls in 1982, produced a mean return of $12.94 per head with a standard deviation of $49.20. As the calls were sold further out-of-the-money, the profit increased as the variance increased. As calls were sold further in-the-money from the at-the-money call, profits decreased but the variance increased.

Buying put options proved to be inferior to cash sales in profitability but did reduce the variance of returns. Profitability of the put option strategy increased and the standard deviation of returns increased as the puts moved from deep in-the-money to deep out-of-the-money.

In general, the fence spreads realized the lowest variability of income but also showed the lowest mean returns of the option-based hedging strategies. Among the fences, the fence with an $8/cwt. width performed the best in profitability while fences with $4/cwt. widths performed the worst.

1983

Cash slaughter cattle prices were cyclical in 1983. Cash prices rose until April, dropped until September and then rose again for the remainder of the year (Figure 5). In 1983, the highest mean return to cash sales ($39.06 per head) was realized, with a standard deviation

Table 5. Net Returns per Head and Variance of Returns for Hedging Strategies, Average for 1983[a]

Strategy	Mean	Standard Deviation	Minimum Value	Maximum Value
Cash	39.06	55.88	-75.28	204.20
Hedge	-14.02*	23.49*	-79.39	70.87
Call +6	26.91*	42.06*	-68.57	119.56
Call +4	20.17*	35.65*	-63.14	88.79
Call +2	12.86*	29.84*	-58.28	88.40
Call 0	5.27*	25.91*	-56.88	93.32
Call -2	-1.78*	23.93*	-62.44	97.15
Call -4	-7.73*	23.49*	-69.46	98.51
Call -6	-12.00*	23.57*	-75.84	96.60
Put +6	-2.95*	29.23*	-83.32	85.14
Put +4	3.38*	35.38*	-84.76	103.36
Put +2	10.43*	42.08*	-84.81	132.33
Put 0	17.48*	47.69*	-82.00	156.29
Put -2	24.22*	51.55*	-83.15	174.68
Put -4	29.62*	53.85*	-82.68	187.49
Put -6	33.49*	55.02*	-79.99	195.29
Calsp 22	48.33*	67.70*	-97.51	236.11
Calsp 44	61.10*	79.35*	-115.21	278.56
Calsp 40	49.10*	70.76*	-94.66	247.82
Calsp 60	55.84*	79.23*	-100.38	281.85
Calsp 42	55.64*	76.09*	-105.64	265.98
Putsp 22	48.15*	68.53*	-99.82	238.30
Putsp 44	59.82*	80.11*	-118.26	278.85
Putsp 40	47.68*	71.89*	-98.05	247.65
Putsp 60	53.17*	80.33*	-104.97	280.18
Putsp 42	54.42*	76.94*	-108.55	266.03
Fence 22	-1.98*	26.17*	-73.06	80.36
Fence 44	10.73*	33.29*	-70.54	75.81
Fence 40	-1.41*	28.34*	-78.40	78.57
Fence 60	5.33*	33.99*	-78.11	73.92
Fence 42	5.33*	31.24*	-72.77	74.07

[a] 217 observations
* Significantly different from cash at $P < .01$

of $55.88 (Table 5). The average feeder cattle price, $61.29/cwt., was lower than the average fat cattle price, $65.51/cwt.. The average breakeven price was $62.00/cwt.. Cattle were on feed an average of 130 days which was the shortest average feeding period of all six years (Appendix C).

Short hedging with futures sustained the greatest losses in 1983. The average loss was $14.02 per head with a standard deviation of $23.49.

Once again the call and put bear spreads produced the highest mean returns and the highest standard deviations of all the marketing strategies. Among these strategies, the spreads with $8/cwt. widths had the highest mean returns and the highest variances. The spreads with $6/cwt. widths had the second highest returns and standard deviations and the spreads with the $4/cwt. widths, showed the lowest mean returns and variances.

At-the-money and out-of-the-money calls were profitable but returns were lower than cash returns. In-the-money calls sustained losses. The variance of selling calls was lower than that of cash and among the calls, the variance was reduced as the calls moved into-the-money.

Buying out-of-the-money puts was the most profitable of the put hedging strategies and the returns decreased as the puts moved into-the-money. The variance of income was also reduced as the returns decreased.

Placing fence spreads in 1983, reduced the variance of income but also reduced the net returns when compared to cash. The fence with an

$8/cwt. spread had a mean return of $10.73 per head, the two fences with six dollar spreads both realized profits of $5.33 per head and the fences with $4/cwt. widths both sustained losses.

1984

Cash prices trended downward in 1984 (Figure 6). The average feeder cattle and slaughter cattle prices were $64.83/cwt. and $64.36/cwt., respectively, and the average breakeven was $64.00/cwt. (Appendix C). Consequently, cash sales realized a positive return of $8.60 per head with a standard deviation of $34.69 (Table 6). This standard deviation was much lower than the six year average standard deviation of $62.56. The results in 1984, were very similar to 1981, when the variance of cash returns was also below the average.

Short futures hedges realized a net return significantly higher than cash and a standard deviation lower than that of the cash sales.

Selling call options was the most profitable of the option based hedging strategies. At-the-money calls had the highest net returns of $21.38, with a standard deviation of $28.01. As the calls moved out-of-the-money the returns decreased and the variance increased. As the calls moved in-the-money the mean returns were also reduced but the variance reduced as well.

In contrast to the calls, the at-the-money put realized the greatest loss of the put option strategies, -$3.08 per head. Losses decreased as the options moved $2/cwt. in- and out-of-the-money. The deep in- and out-of-the-money puts showed a positive return. Both the call and put spreads reduced the mean income while increasing the

Table 6. Net Returns per Head and Variance of Returns for Hedging Strategies, Average for 1984[a]

Strategy	Mean	Standard Deviation	Minimum Value	Maximum Value
Cash	8.60	34.69	-140.22	86.40
Hedge	12.59*	24.34*	-84.78	80.64
Call +6	14.12*	33.71*	-131.77	91.20
Call +4	17.09*	32.48*	-125.86	91.82
Call +2	19.91*	30.43*	-117.86	88.30
Call 0	21.38*	28.01*	-106.04	83.04
Call -2	20.29*	26.12*	-97.34	81.24
Call -4	17.69*	24.85*	-87.95	77.34
Call -6	14.34*	24.30*	-84.12	72.64
Put +6	6.17**	24.24*	-94.21	70.52
Put +4	2.50*	24.34*	-100.49	64.76
Put +2	-0.92*	25.07*	-108.92	56.97
Put 0	-3.08*	26.84*	-121.02	64.33
Put -2	-2.35*	29.14*	-132.05	73.60
Put -4	-0.19*	31.79*	-141.48	79.68
Put -6	2.43*	33.79*	-146.49	82.88
Calsp 22	2.45*	42.98*	-167.51	101.85
Calsp 44	1.66*	50.34*	-185.47	114.57
Calsp 40	-0.49*	41.02*	-159.78	99.21
Calsp 60	-3.46*	42.74*	-165.69	107.09
Calsp 42	-0.38*	46.14*	-175.51	108.37
Putsp 22	1.37*	43.59*	-170.28	102.30
Putsp 44	-0.49*	50.92*	-188.75	114.27
Putsp 40	-3.38*	41.92*	-168.29	98.92
Putsp 60	-7.69*	43.56*	-175.25	105.15
Putsp 42	-2.65*	46.70*	-179.33	108.20
Fence 22	8.96	25.57*	-109.69	72.51
Fence 44	8.29	29.65*	-127.11	85.10
Fence 40	5.40*	25.36*	-106.66	69.75
Fence 60	2.44*	26.20*	-112.57	69.13
Fence 42	6.14*	27.21*	-117.69	79.03

[a] 281 observations
* Significantly different from cash at $P < .01$
** Significantly different from cash at $P < .05$

standard deviation as compared with the unhedged cash sales.

Two of the fence spreads, fence 22 and fence 44, resulted in mean returns very similar to cash, but reduced the variance significantly. The remaining three fence spreads reduced both profits and variance.

1985

Cash prices trended downward steadily from $67.00/cwt. at the first of the year to $52.00/cwt. by August. They then rebounded and climbed back up to $68.00/cwt. by December and finished the year around $66.00/cwt.(Figure 7). The average cash price for slaughter cattle in 1985 was $64.29/cwt. with the average breakeven at $63/cwt.(Appendix C). Cash marketing produced an average cash sales loss of $29.90 per head, with a standard deviation of $73.83. As expected when prices are trending down, hedging with futures produced the highest mean return of $16.78 per head profit. The futures hedging standard deviation of $37.17 was the lowest of all marketing strategies as well.

In-the-money puts also provided positive returns and lower standard deviations than cash. The deeper the put was in-the-money, the greater the profit and the lower the variance of returns. The at-the-money put produced a loss of $2.55 per head and a standard deviation of $44.76. As the puts moved out-of-the-money, the loss was greater as was the variance.

While the call selling strategies provided smaller losses than the cash only strategy, they also lowered the variance of returns. The losses and standard deviations increased as the calls moved from

Table 7. Net Returns per Head and Variance of Returns for Hedging Strategies, Average for 1985[a]

Strategy	Mean	Standard Deviation	Minimum Value	Maximum Value
Cash	-29.90	73.83	-261.28	151.62
Hedge	16.78*	37.17*	-122.57	110.27
Call +6	-25.97*	69.50*	-242.71	136.40
Call +4	-22.65*	66.45*	-233.67	123.40
Call +2	-19.80*	62.22*	-222.16	116.61
Call 0	-14.44*	57.21*	-207.78	113.40
Call -2	-8.81*	52.13*	-190.52	108.73
Call -4	-3.71*	47.40*	-174.49	106.57
Call -6	1.51*	42.66*	-157.23	103.16
Put +6	11.17*	39.64*	-165.51	102.83
Put +4	8.64*	40.03*	-151.94	98.86
Put +2	4.51*	42.79*	-164.61	114.22
Put 0	-2.55*	44.76*	-179.46	115.09
Put -2	-7.34*	51.40*	-197.74	138.02
Put -4	-14.77*	57.72*	-217.88	144.48
Put -6	-18.07*	62.45*	-236.44	174.75
Calsp 22	-45.73*	87.23*	-300.39	170.31
Calsp 44	-54.35*	100.19*	-331.34	192.25
Calsp 40	-39.96*	83.76*	-286.09	175.64
Calsp 60	-43.28*	87.95*	-295.13	188.64
Calsp 42	-48.58*	92.67*	-311.90	185.65
Putsp 22	-47.21*	87.77*	-303.77	172.13
Putsp 44	-59.28*	102.81*	-337.47	191.59
Putsp 40	-47.05*	83.36*	-299.05	162.20
Putsp 60	-50.14*	87.47*	-309.74	174.54
Putsp 42	-51.84*	93.34*	-317.33	185.13
Fence 22	2.76*	41.60*	-158.62	103.45
Fence 44	-7.53*	50.32*	-190.27	116.26
Fence 40	4.70*	40.08*	-151.85	99.85
Fence 60	1.37*	41.96*	-160.89	99.87
Fence 42	-0.09*	44.52*	-170.13	109.80

[a] 232 observations
* Significantly different from cash at $P < .01$

in-the-money to out-of-the-money.

Placing call and put spreads substantially increased the loss and variance of income in 1985. The fences 22, 40 and 60 produced positive net returns while the fences 44 and 42 decreased the losses of productions as compared to cash. All of the fence spreads significantly reduced the variance of returns when compared to the unhedged cash sales.

CHAPTER VI

Discussion and Conclusions

Because of the assumptions and methods used in this study, the results are very specific to one particular feedyard and to the time period studied. One must be cautioned against liberal comparisons between this study and past or present studies.

The final computations of this study show many expected and some unexpected results. Not surprisingly, feeding cattle was profitable during the 1980 through 1985 period as the mean return for cash marketing was $11.17 per head. This study did unveil one major unexpected result. Short hedging via the futures markets did not produce a mean return significantly different from cash. In fact, the mean return was slightly higher than the cash returns. This contrasts previous studies involving routine hedging.

Possible reasons for the discrepancy follow. First, by not normalizing the data, the results and implications are very specific to one feedyard. It is possible that incorporating data from several feedyards or using averaged data from several locations may offer different results. Another speculation for the observed discrepancy may be that the time over which this study covered was significantly different from the time periods covered by other studies. The 1980 to 1985 time period covered in this study experienced a cyclical but definite sideways trend (figure 1). Because a long upward trend in the market was not sustained, hedging with futures did not record losses for any extended time period.

As tables 2 through 7 show, routinely hedging with futures produced a net loss in only one of six years and that was in 1983 when cash profits were the highest of the six years studied. This sideways trending market seems to be the most appropriate explanation for the futures hedging returns being similar to cash.

As one would expect, hedging with futures greatly reduced the variability of income. Over the six year period, the standard deviation was reduced by 39%. This finding is very similar to previous studies.

Sporleder and Winder (1986) suggest from their research over the 1980 to 1984 period, that selling at-the-money calls was a leading strategy when the market was stable. These results tend to support their claim. Selling at-, in- and out-of-the-money calls produced mean returns that were not significantly different from the mean return of cash only marketing. They also reduced the variance of returns. Table 1 shows that selling at-the-money calls was the most profitable of the call selling strategies with a mean return slightly higher than the cash mean return ($11.39 per head).

Tables 2 through 7 show that selling calls increased profitability in four of the six years studied when compared to cash sales. In 1982 and 1983 cash returns were the highest of the six years, $33.16 and $39.06 per head, respectively. This may be intuitive because, realistically,the call selling strategy is a "loss reduction" not a price "lock-in" strategy. When prices fall, the producer's income is reduced or negative, but by selling calls he is better off by the amount of the premium received, if the call expires.

When a call is sold, the seller incurs an obligation to act in accordance with the holder's discretion. If prices rise the call moves into-the-money and its value increases to the buyer. The buyer would then either exercise or offset the call. The seller must accept the other side of the transaction and therefore, incurs a loss.

In 1982 and 1983 when cash prices went up, the producer profited from the cash sales less any losses on the option transaction. This is why the call selling strategies produced a mean return less than cash sales in these two years. The difference in the net return is the loss on the option transaction.

Also, as one might expect, routinely selling calls reduced the risk of production by decreasing the variance of returns for the entire six year period and for each of the individual years as well. This lends support to the recommendation of selling calls as a routine hedging strategy when prices are stable or sideways trading.

Buying in-the-money puts produced mean returns that were also not significantly different from the mean returns to cash only marketing. At-the-money and out-of-the-money puts produced lower mean returns. This violates a current rule of thumb suggested by many marketing specialists. This rule suggests that a producer should buy at-the-money or slightly out-of-the-money puts to establish a price floor. By buying at- or out-of-the-money puts, this floor price could be established at a minimal cost.

This study suggests that paying the higher premium for the added insurance over the long run is more profitable and less risky. In fact, the more in-the-money the put was, the greater the returns and

the lower the variance of returns. This research shows that routinely selling in-the-money put options produces a mean return similar and possibly slightly greater than cash marketing and significantly reduces risk, by decreasing the variance of returns. These results could possibly alter the current marketing advise being offered to producers.

Returns for in-the-money puts were also comparable to straight futures hedging returns. In theory, both offer downward protection and thus reduce the risk of income variability. Table 1 shows that buying puts $6 in-the-money produced a mean return and standard deviation of returns very similar to a routine futures hedge for the six year period. Put options are more versatile than straight futures hedges. Once a futures hedge is placed, the price is locked in, ignoring basis fluctuations, and if the cash price rises, the producer loses the windfall profits. Put options are designed to allow the producer to capture part of these windfall profits by allowing the put option to expire. Therefore, the producer could sell his cattle and collect the windfall profit less the premium lost by allowing the option expire.

Tables 4 and 5 show in 1982 and 1983, the cash returns were the highest. This suggests that the cash markets had an upward bias during those two years. In both years, in-the-money puts had higher returns than futures hedging.

Tables 2 and 7 show that when the cash markets were moving lower, hedging with futures performed superiorly to buying put options. This is explainable by the fact that a premium was paid for the options

while none was paid for the futures hedge. Therefore, the returns should be less for puts than for future hedges by the amount of the premium paid.

This supports the idea that if the market is expected to move lower, it would be more profitable to hedge via the futures markets. But, if there is any suspicion that the price might go up, it may be advisable to pay the premia and buy put options.

Although call and put bear spreads produced positive returns for the duration of the study, the returns were significantly lower and the variance of returns was higher than that of the unhedged cash sales. Tables 4 and 5 show that in 1982 and 1983, routinely placing bear call and put spreads was more profitable than not hedging. But, while the profits were increased, the risk was also increased as the standard deviations were higher than that of cash sales. This clearly eliminates routinely placing these spreads as risk reduction tools.

On the contrary, fence spreads consistently reduced the variance of returns for the entire six years and for each individual year studied. While the net returns were lowered, the decrease in risk associated with fence spreads allows them to be a very promising hedging instrument.

For the six year period, fences $4 in width produced the highest mean returns of the fence spreads. Tables 4 and 5 show that in 1982 and 1983 when prices were rising, fences with an $8 width were the most profitable but did not produce the lowest variance of returns. Theoretically, this is easily explainable by the fact that in 1982 and 1983 there were wide swings in the market. Prices ranged from the

upper-50's to the low-70's. Fence spreads are most profitable if the futures price remains between the strike prices of the long put and the short call. In these two years, the eight dollar width allowed the price to stay between the two strike prices more often than fences with $6/cwt. and $4/cwt. widths. In fact, the fence with the $8/cwt. spread out-performed straight futures hedges in profitability and risk reduction in these two years.

These results suggest that fence spreads are a viable risk reduction tool and are also flexible enough to be used in selective hedging strategies.

Conclusions

Data were obtained from a western Kansas feedyard for 1600 pens of steers placed on feed from January 1980 to December 1985. Using this data, option-based hedging strategies were simulated and compared with unhedged cash marketing for the entire six year period and for each of the individual years. The strategies evaluated were: 1) short call options, 2) long put options, 3) bear call spreads, 4) bear put spreads and 5) fence spreads. Each of call selling and put buying strategies were routinely placed at seven different strike prices and each of the spreads were routinely placed at three different widths.

It was anticipated that option-based hedging strategies would produce mean returns similar to cash marketing returns and reduce the variability of returns for the six year period. Selling call options at all seven strike prices and buying in-the-money put options

produced returns that were not statistically different from the returns of cash only marketing.

Selling at-the-money calls and buying puts $6 and $4/cwt. in-the-money actually were slightly more profitable than cash sales. All of these call and put hedging strategies exhibited variances less than that of the cash market as well. These results suggest that routinely selling call options and buying in-the-money put options are leading hedging strategies when the market is sideways trending.

The cash market was upward trending in 1982 and 1983. It was expected that during this time of rising prices, cash sales would generate returns higher than any of the hedging strategies. This was not the case as both call and put bear spreads produced mean returns higher than cash sales. Unfortunately, they also increased the variance of returns as well. Consequently, bear call and put spreads cannot be recommended as hedging strategies that producers could utilize to reduce risk.

Buying put options was anticipated to be more profitable than cash marketing when prices were trending downward, as was the case in 1980 and 1985. While cash sales sustained losses in both years, buying puts yielded positive returns in 1980 and recorded smaller losses in 1985. Unexpectedly, fence spreads also increased income and reduced risk in both years when compared to unhedged cash sales.

In years when the market moved sideways, selling call options was expected to be the leading option-based hedging strategy. In 1981 and 1984 the market did, basically, move sideways and selling call options was the most profitable hedging strategy those years.

Because fence spreads consistently reduced the variance of returns and only reduced returns slightly compared to cash marketings, they should be recommended as a risk reduction hedging strategy.

The results of this study suggest that routinely selling calls, buying puts and placing fence spreads are leading strategies when the markets are sideways trending. How will these hedging strategies perform in a different time period? Perhaps simulating option-hedging strategies for the 1970 to 1980 time period would provide some additional insight into the use of options as a marketing tool.

Another issue regarding options as a marketing tool is their use in selective hedging strategies. Perhaps the use of a triggering device would help place the hedge at a level that would further increase profits and reduce risk. Combining the futures markets with option hedges is an alternative that also needs researching. Fence spreads appear to be a promising hedging tool for risk reduction. These spreads need to be evaluated in selective hedging strategies to identify a superior hedging approach. Naturally, the Black Model for estimating premia for options on futures contracts needs to be evaluated empirically. There is sufficient data currently available to compare actual premiums to estimated premiums from 1985 forward.

Concerning the study in particular, some suggestions for improvement are appropriate as closing remarks. The feedlot data should be normalized to remove any seasonality of cattle placements that may be present in these results. Additionally, this data set needs to be continually updated to provide current research that will enable Kansas cattle feeders to operate profitably.

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APPENDICIES

APPENDIX A

Sample of a feedlot closeout

OWNER:_____

PEN NO. B1

DATE IN YARD 12/23/85

DATE OUT OF YARD 5/8/85

NO. HEAD IN 381'h

DEATH LOSS 0 GRADE & YIELDS 0

NO. HEAD OUT 381'h

TOTAL GAIN 153201 GAIN # PHPD 2.97

TOTAL FEED 1451700 CONV. 9.47

FEED # PHPD 28.22

TOTAL COST 85825.80 COST PER # GAIN 56.02

FEED COST PHPD 1.66

TOTAL HEAD DAYS 51435 DAYS ON FEED 135

PAY WT. 257285 AVE. WT. 675

RECEIVED WT. 232880 AVE. WT. 611

SHRINK 24405 % 9.5

PAY WT. OUT 410486 AVE. WT. 1077

SOLD TO Val ag @ 59.75

APPENDIX B

Equations used to estimate net returns

1. Cash sales net return = ((total receipts - total costs)/# of head).

2. Short call net returns if the option expires[a] = ((cash returns + ((premium recieved * # of contracts) * 400) - (commissions + interest on commissions + interest on margin money))/#of head).

3. Short call net returns if the option is offset = ((cash returns + (((premium received - premium paid) * # of contracts) * 400) - ((commissions * 2) + interest on commissions + interest on margin money))/# of head).

4. Long call net returns if the option expires[b] = ((cash returns - ((premium paid * 3 of contracts) * 400) - (commissions + interest on commissions + interest on premium paid))/ # of head).

5. Long call net returns if the option is offset = ((cash returns + (((premium received - premium paid) * # of contracts) * 400) - ((commissions * 2) + interest on commissions + interest on premium paid))/# of head).

6. Long put net returns if the option expires[c] = ((cash returns - ((premium paid * # of contracts) * 400) - (commissions + interest on commissions + interest on premium paid))/# of head).

7. Long put net returns if the option is offset = ((cash returns + (((premium received - premium paid) * # of contracts) * 400) - ((commissions * 2) + interest on commissions + interest on premium paid))/# of head).

8. Short put net returns if the option expires[d] = ((cash returns + ((premium received * # of contracts) * 400) - (commissions + interest on commissions + interest on margin money))/# of head).

9. Short put net returns if option is offset = ((cash returns + (((premium received - premium paid) * # of contracts) * 400) - ((commissions * 2) + interest on commissions + interest on margin money))/#of head).

APPENDIX B, continued

10. Bear call spread net returns = ((net returns from long call + net returns from short call) - cash returns).

11. Bear put spread net returns = ((net returns from long put + net returns from short put) - cash returns).

12. Fence spread net returns = ((net returns from short call + net returns from long put) - cash returns).

[a] Short call option would expire if premium paid < commissions.
[b] Long call option would expire if premium received < commissions.
[c] Long put option would expire if premium received < commissions.
[d] Long put option would expire if premium paid < commissions.

APPENDIX C

Summary of feedlot data by year, 1980-1985

Variable[a]	YEAR						
	1980	1981	1982	1983	1984	1985	Average
Number of pens	284	296	290	217	281	232	267
Steers/pen	191	202	211	217	245	230	216
Feeder weight (lbs)	699	715	728	760	753	753	735
Slaughter weight (lbs)	1135	1138	1115	1146	1160	1191	1147
Days on feed	148	142	131	130	137	140	138
Feeder price ($/cwt.)	72.88	65.74	64.72	61.29	64.83	63.62	65.75
Slaughter price ($/cwt.)	67.10	65.16	65.11	65.51	64.36	57.52	64.29
Minimum value ($/cwt.)	58.00	57.00	57.00	58.00	56.00	44.50	44.50
Maximum value ($/cwt.)	73.00	74.50	75.50	72.00	68.50	68.00	75.50
Cost/lb gain ($)	.53	.53	.52	.60	.57	.50	.54
Break even ($/cwt.)	68.00	63.00	62.00	62.00	64.00	60.00	63.00

[a] Averages

AGRICULTURAL COMMODITY OPTIONS: AN EVALUATION OF PERFORMANCE IN ROUTINE LIVE CATTLE HEDGES

by

SCOTT ANTHONY LANGEMEIER

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Manhattan, Kansas

1987

Five routinely placed option hedging strategies were simulated and compared to unhedged cash sales for profitability and risk reduction in marketing live cattle. This study involved 1600 pens of steers that were placed on feed from January, 1980, through December, 1985. Black's model was used to estimate premia for options on futures contracts. The option hedging strategies evaluated included: 1) selling calls, 2) buying puts, 3) vertical bear call spreads, 4) vertical bear put spreads and 5) fence spreads. Each of the short call and long put strategies were routinely placed at seven strike prices and each spread was simulated at three different widths.

Based on these data, cattle feeding was profitable during the 1980 through 1985 period as the mean return for cash marketing was $11.17 per head. During this same period, futures hedges produced a mean return of $12.52 per head and reduced the variance of returns by 39 percent.

It was anticipated that option-based hedging strategies would produce mean returns similar to cash marketing returns and reduce the variability of returns for the six year period. Selling call options at all seven strike prices and buying in-the-money put options produced returns that were not statistically different from the returns of cash only marketing and reduced the variance of income in all cases. These results, suggest that selling calls and buying in-the-money puts are leading hedging strategies when the market prices are sideways trending.

The cash market was upward trending in 1982 and 1983. It was

expected that during this time of rising prices, cash sales would generate returns higher than any of the hedging strategies. This was not the case as both call and put bear spreads produced mean returns higher than cash sales. Unfortunately, they also increased the variance of returns as well. Consequently, these spreads cannot be recommended as hedging strategies that producers could utilize to reduce risk.

Buying put options was anticipated to be more profitable than cash marketing when prices were trending downward, as was the case in 1980 and 1985. While cash sales sustained losses in both years, buying puts yielded positive returns in 1980 and recorded smaller losses in 1985. Unexpectedly, fence spreads also increased income and reduced risk in both years when compared to unhedged cash sales.

Fence spreads consistently reduced the variance of returns and reduced returns slightly when compared to cash marketings for the six year period studied. Therefore, fence spreads should be recommended as a risk reduction hedging strategy.

The results of this study suggest that routinely placed option-based hedging strategies can be a viable alternative to futures hedging for reducing risk. Further research needs to be conducted to evaluate selectively placed option hedging strategies as a means to further reduce risk and possibly increase the returns to cattle feeding.